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MEMOIRS OF THE GEOLOGICAL SURVEY.
ENGLAND AND WALES.

THE WATER SUPPLY OF BEDFORDSHIRE AND NORTHAMPTONSHIRE, FROM UNDERGROUND SOURCES:

WITH RECORDS OF SINKINGS AND BORINGS.

BY

HORACE B. WOODWARD, F.R.S., F.G.S.,

AND

BEEBY THOMPSON, F.G.S., F.C.S.,

WITH CONTRIBUTIONS ON RAINFALL BY

HUGH ROBERT MILL, D.Sc., LL.D.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY.

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By WYMAN and SONS, LIMITED, 109, FETTER LANE, E.C.

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PREFACE.

In the present Memoir it has been found convenient to include records of the wells in the two counties of Bedford and Northampton.

In the preparation of the material now published, we have been primarily indebted to many well-sinkers, whose names are recorded in the text, for data obtained in shafts and borings and given by them for the most part in acknowledgment of information supplied at this Office.

With regard to Bedfordshire, many records of wells and borings were procured during the course of the six-inch Geological Survey by Mr. A. C. G. Cameron, and other records were obtained by Mr. A. J. Jukes-Browne. For the classification of the strata in the documents relating to this county Mr. Woodward is mainly responsible.

With regard to Northamptonshire, we are chiefly indebted to Mr. Beeby Thompson, who for many years has devoted attention to questions of water-supply, and has assiduously gathered the local records of wells and borings. The results of his intimate knowledge of the geology of the county, as bearing on water-supply, have now been placed at our service; and especial attention may be called to his full historical account of the water-supply of the town of Northampton.

To the Local Government Board, through Dr. H. Franklin Parsons, we are indebted for sundry records of borings and many analyses. Similar assistance has been rendered by Mr. Henry Preston, Dr. J. C. Thresh, and Mr. Whitaker—to the last-named, indeed, we are under perpetual obligations. Dr. H. R. Mill has, as usual, contributed the sections on rainfall.

In the preparation of the MS. for the printer Mr. Woodward received much assistance from Mr. Henry Dewey.

J. J. H. TEALL,
Director.

Geological Survey Office,
28, Jermyn Street, London,
21*st*, *March*, 1908.

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NOTE.

The following initials refer to the annexed authorities:—

A. C. G. C.	Mr. A. C. G. Cameron.
A. J. J. B.	Mr. A. J. Jukes-Browne.
B. T.	Mr. Beeby Thompson.
H. B. W.	Mr. H. B. Woodward.
H. F. P.	Dr. H. Franklin Parsons.
H. P.	Mr. Henry Preston.
W. W.	Mr. William Whitaker.

THE WATER SUPPLY OF BEDFORDSHIRE AND NORTHAMPTONSHIRE,

FROM UNDERGROUND SOURCES.

INTRODUCTION.

OUTLINE OF THE GEOLOGY.

By H. B. Woodward, with Notes by Beeby Thompson and A. J. Jukes-Browne.

The geological formations which are exposed at the surface in the counties of Bedford and Northampton, range from the Lower Lias on the north-west to the Chalk with Eocene outliers on the south-east. In addition there are extensive coverings of Superficial Deposits in the valleys and on the uplands. The general inclination of the so-called "Solid" Strata is to the south-east, and in consequence we cross their successive outcrops, which trend north-east and south-west, in passing from the Lias on the borders of Leicestershire to the Chalk ranges near Luton which form northern portions of the London Basin.

This regularity is, however, modified in two ways, by undulations and faults in the Jurassic strata, and by the unconformity and overlap of the Cretaceous formations. These modifications have considerably influenced the physical features.

The following is a list of the Geological Formations represented in the two counties:—

				Bedford.	North-ampton.
Recent		Alluvium, fen silt, loam, gravel, peat, &c.		×	×
Pleistocene		Valley gravel and loam		×	×
		Estuarine and marine gravel		–	×
		Boulder-clay	Glacial drift.	×	×
		Glacial sand and gravel		×	×
		Loam		×	–
		Clay-with flints		×	–
Eocene		Reading Beds (clay and sand)		×	–
Upper Cretaceous		Upper Chalk (with flints)		×	–
		Middle Chalk (with few flints)		×	–
		Lower Chalk		×	–
		Upper Greensand		×	–
		Gault (clay)		×	–
Lower Cretaceous		Lower Greensand (sands, sandstone, clay and Fuller's earth)		×	–
Jurassic	Oolitic.	Kimeridge Clay		×	–
		Ampthill Clay		×	–
		Oxford Clay		×	×
		Kellaways beds (sandstone, sand, and clay		×	×
		Cornbrash (limestone)		×	×
		Great Oolite Clay and Forest Marble		×	×
		Great Oolite Limestone		×	×
		Upper Estuarine Series (clays and sand)		×	×
		Lincolnshire Limestone		–	×
		Northampton Beds	Lower Estuarine Series (sands and clay)	–	×
			Northampton Sand	× ×	×
	Liassic.	Upper Lias (clay)		× ×	×
		Middle Lias	Marlstone (rock-bed)	× ×	×
			Clays and sand	× ×	×
		Lower Lias (clays and limestones)		× ×	×
Triassic		Rhætic Beds (limestone, shale, marl, sandstone, etc.)		–	× ×
		Keuper, &c. (marl, sandstone, and conglomerate)		–	× ×
		Carboniferous Limestone		–	× ×
		Old Red Sandstone ?		–	× ×
		Volcanic rock (probably Archæan)		–	× ×

× Occur at surface. × × Proved by boring, but not exposed.

Physical Features.

With regard to the main features we have six belts of alternating vale and upland trending from south-west to north-east.

Welland Valley.

1. The Lias vale, traversed in part by the Warwickshire Avon, and, more extensively along the county boundary of Northamptonshire, by the Welland.

Northampton Uplands.

2. A broad belt of uplands formed by the Lower Oölitic series which extends from Brackley to the north-eastern part of Northamptonshire between Stamford and Peterborough. This upland region is divided by valleys cut down to the Lias by the head waters of the Great Ouse, and by the Nene and its tributaries, as at Towcester, Northampton, Wellingborough and Kettering. Thus dissected it includes many large outlying masses, together with smaller outliers as at Daventry, Naseby, &c. Oxford clay extends on to the plateau west of Oundle, and Boulder clay and other Drift deposits conceal the Jurassic formations in many tracts.

Bordering the Lias vale the scarp of Lower Oolites rises from 225 feet in Burghley Park, south of Stamford, to 375 feet at Gretton, 425 at Rockingham, and about 470 near Desborough. To the south and south-west the ground rises to a height of 424 feet at Rothwell, 500 at Great Oxendon, 612 at Naseby, and 661 at Cold Ashby. To the east of the above localities, more especially along the borders of the Nene Valley below Wellingborough, the heights decrease to about 260 feet, as at Finedon, Benefield and King's Cliffe. To the south of the Nene there are elevations of 475 feet at Brackley, 521 at Whittlebury, and 333 at Yardley Hastings.

Between Peterborough and Stamford there is evidence of considerable disturbance, a line of fault extending from Paston north of Peterborough to the Welland valley south of Stamford. On the northern side of the fault the strata are bent into an anticline, itself dislocated by faults, and the outcrop of Oxford clay is shifted westwards so that at Barnack the Oxford clay on the north, or downthrow side, is brought against the Upper Lias; the displacement amounting to about 200 feet.

The effects of the anticline are seen on the southern side of the fault along the Nene valley where the Upper Lias, which underlies the Alluvium as far as the neighbourhood of Oundle, is exposed also on the borders of the valley in limited tracts both north and south of that town.

The effects of minor faults and undulations, which have led to inlying exposures of Upper Lias, are seen in the neighbourhood of Corby, Stanion, Great and Little Oakley, and Brigstock, as shown on the Geological Survey map prepared by Prof. J. W Judd.

Vale of Bedford.

3. The Vale of Bedford, for the most part a broad undulating tract of Oxford clay, extends from Aspley Guise and Cranfield to Eaton Socon and Tillbrook, and onwards along the borders of the Nene Valley.

An inlying tract of Lower Oolite occurs along the Ouse Valley from Bedford to Sharnbrook and Harrold, due to a gentle undulating anticline.

The vale is covered with a good deal of Alluvium, Valley Gravel, and Boulder Clay. The last-named occurs on the higher grounds, which rise in places to 300 feet : the Valley Gravel borders the Ouse and the Ivel.

Woburn Hills.

4. The uplands of Lower Greensand which extend from Leighton Buzzard and Woburn through Ampthill to Sandy and Potton, are capped here and there by Boulder Clay.

The Woburn Hills rise to about 400 feet at Woburn, and to 300 at Ampthill.

Barton Valley.

5. This clay vale, formed by Gault, Chalk Marl, and Boulder Clay, extends from Billington near Leighton Buzzard, to Barton-in-the-Clay and Wrestlingworth.

Dunstable and Luton Downs.

6. The chalk range of the Chiltern Hills, or that extension of them known as the Dunstable and Luton Downs, rises to 782 feet south-west of Dunstable, and to more than 600 feet north of Luton.

GEOLOGICAL FORMATIONS.

Pre-Triassic.

There is no need to refer here in detail to the older rocks that have been proved in the deep borings at Gayton, Kingsthorpe, Northampton, and Orton. Particulars of the rocks have been given in the records of the borings.

Trias.

Referring to Northamptonshire, Mr. Beeby Thompson states hat the greatest thickness of Triassic rocks was encountered at Kingsthorpe; and if we include the lower conglomerate as of Triassic age (*see* section of Kingsthorpe shaft), and exclude the upper conglomerate as probably of Rhætic age, the thickness is 87 feet, made up of Red Sandstone 60 feet, Red Marl 12 feet, and Conglomerate 15 feet. It may be actually a little more than 87 feet thick, as the lower Conglomerate was not pierced.

He has also remarked that "The Trias furnishes the deepest source of water so far tapped within the county. The water is very salt, containing from 1,200 to 1,500 grains of solid matter per gallon, also it is very moderate in quantity, 100,000 to 200,000 gallons per day from a single well or boring. The water rises 535 feet from a depth of 436 feet below sea-level, taking an average of the four places where it has been encountered."[1]

LIASSIC.

Lower Lias.

The Lower Lias is exposed over a small area along the north-western borders of Northamptonshire. It comprises two subdivisions, the upper of which is mostly clay with occasional bands and nodules of limestone; the lower includes the "Blue Lias" limestones and clays or shales, an alternating series of comparatively thin bands, with at the base a mass of clays locally as much as 60 feet thick.

---

[1] "Vict. Hist. of Northamptonshire," *Article "Geology,"* p. 38.

The thickness of these sub-divisions may be estimated as follows:—

		Feet.
Lower Lias Clay - - - - - -	about	350
Lower Lias Limestones and Clays - -	about	150
	about	500

The upper sub-division is not water-bearing. The lower sub-division is not exposed in our district; from it limited supplies of water are obtained in other regions generally near the outcrop.

Mr. Thompson observes that the actual total thickness of the Lower Lias in Northamptonshire is not known with certainty, because the junction of the zone of *Ammonites margaritatus* (base of Middle Lias) with that of *Ammonites capricornus* has not been determined in any of the deep borings. He adds that within the county of Northampton where borings have been made, the limestone-beds of the lower part of the Lower Lias are not such a conspicuous feature as they are about Rugby, and no water is yielded by any part of the Lower Lias.

Middle Lias.

BY B. THOMPSON.

The Middle Lias of Northamptonshire is about 100 feet thick, and may be divided into three main portions:—

Ammonites spinatus Zone.	1. The Marlstone or Middle Lias rock-bed. A calcareous, or sandy, or ferruginous bed. The zone is represented by two or more thin hard beds with intervening clays in some places.
Upper *Ammonites margaritatus* Zone	2. Alternating thin hard and thicker soft beds; micaceous sandstones, or marlstones, and micaceous sandy clays, with a well marked mottled rock-bed at the base containing pebbles and rolled fossils.
Lower *Am. margaritatus* Zone or *Am. nitescens* Zone	3. Calcareous, sandy, micaceous clays with hard beds at intervals, and a well marked pebble bed at the base containing rolled fossils.

The two upper divisions, which together are only 21 feet thick at Northampton, are about 40 feet thick in the western parts of the county, and constitute the most important part of the Middle Lias from the point of view of water-supply.

Water supply from the Middle Lias of Northamptonshire is a complicated problem.

The so-called Marlstone, or rock-bed, the uppermost bed of the Middle Lias, is the most reliable source of water over a large area, but in certain directions it fails. Where it fails lower hard rocks may take its place in yielding water, but in an untried area there is no certainty that they will.

Actually five distinct horizons, at least, in the Middle Lias yield water, but not more than four have been detected in any one locality.

For instance, in the western parts of the county, at and around Badby, there appears to be clear evidence, derived from springs mostly, that four water horizons occur, separated by the intervals 39, 29, and 25 feet respectively. The top one is the Marlstone or rock-bed supply, the bottom one—a very good one here—the base of the Middle Lias, the total thickness of the Middle Lias indicated being 93 feet or a little more. Working eastward, at Little Everdon the three upper springs appear to be about 42 and 28 feet apart; at Weedon intervals of 39, 29, and 25 feet are indicated by the four springs, the same as at Badby; at Floore 34, 16, and 30 feet are the intervals indicated by springs; and at Upper Heyford the three upper ones appear to be 37 and 3 feet apart[1]. Singularly, some of the wells about Floore (*cf.* Floore and Floore Hill) in the making lost their water at successive hard porous beds until the bottom one, or at least a low one, was reached.

In Northampton, north of the Nene Fault, deep wells derive their water from the Marlstone; on the south side of the fault, either from Marlstone or from the mottled rock at base of No. 2 (*cf.* Northampton wells), which rock is probably the second water-source in all the examples given above, though the space interval is less at Northampton than further westward.

In other parts of the county of Northampton where the rock-bed of the Middle Lias is generally or sporadically absent, or feebly represented, the hard bed next below, some 9 or 10 feet only, tends to emulate the water-bearing functions of the rock-bed proper (*cf.* Brington, Long Buckby, Teeton and Hollowell), thus giving a fifth spring. This, however, cannot be relied upon where the rock-bed fails, as absence of water at the Orton boring, and the failures at Desborough, Burton Latimer, and Wymington testify.

In those places or directions where four springs can be detected there is little doubt that the whole Middle Lias is essentially porous to the extent that it can, slowly, both take and yield water.

The Marlstone "supplied Northampton with water, by an artesian well, for forty years; it has been tapped as far eastward as Kettering and Finedon, but all borings into it southward and eastward of the Nene have been failures."[2]

Reservoirs for the supply of canals are situated at Byfield, Braunston, Daventry, Welford and Naseby; these are fed chiefly by the Marlstone or other beds of Middle Lias, though Drift beds contribute.

Upper Lias.

BY B. THOMPSON.

This formation consists mainly of clay or shale with numerous isolated nodules or cement stones, or bands of such nodules. In the lower 6 to 12 feet are usually found three thin beds of argillaceous limestone containing numerous fossils, the two upper ones often abound in ammonites and in consequence are described as Cephalopoda beds, with *Ammonites communis* above, and *Am. serpentinus* below; the lowest one may be embedded in thinly laminated shale (paper-shale), or it may be joined on to the Middle Lias rock-bed forming with it, and mostly with an intermediate hard marl known as the Transition-bed, one block of stone. This lowest hard bed of the Upper Lias is known as the Fish-bed, because of the abundance of fish fragments in it. The two upper hard beds may be from 6 inches to 18 inches in thickness, the intervening clay-beds being from 2 to 6 feet in thickness. There is probably no bed in the whole of the Lias—Upper, Middle or Lower—so persistent in occurrence, in lithological character, and in fossil contents, over Northamptonshire, as the top one of the three beds referred to above—the top bed or Cephalopoda bed of the Communis zone of the various sections of wells.

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[1] The variation in space interval between the springs may be partly due to the direction and distance apart of the springs, no allowance for dip having been made, and the levels were taken with a barometer.

[2] Thompson, "Vict. Hist. of Northamptonshire," *Article* "*Geology*," p. 38.

The thickness of the Upper Lias may be put at 180 to 190 feet around Northampton, 140 feet in the south-westerly parts of the county (*cf.* Wappenham), perhaps only 109 feet at Brackley, 210 feet or more in northerly parts (*cf.* Desborough); and reduced probably to about 85 feet in the north-east, towards Peterborough (*cf.* New England). In Bedfordshire it is between 60 and 70 feet thick.

As to water—no portion of the Upper Lias is used as a permanent source of water so far as the writer knows. The Cephalopoda-bed referred to above, that is to say the uppermost of the three hard beds near the base of the Upper Lias, usually does yield water when first encountered in a well, which water may rise to a considerable height (*cf.* Finedon), but the water is practically always bad, being loaded with salts and containing much ammonia, while generally the quantity of water is small. For a possible exception and probable explanation, see Church Brampton Lodge (p. 83).

About 13 to 15 feet down in the Upper Lias, that is below the junction of the Upper Lias with the Northampton sand, over quite a large area there is an oyster-bed which yields a little water.[1] It is of no practical importance for water, but furnishes a good horizon.

INFERIOR OOLITE SERIES.

Northampton Beds.

By B. Thompson.

The term Northampton Beds has been applied to the strata occurring between the Upper Estuarine beds of the Great Oolite (or the Lincolnshire Oolite where developed) above, and the Upper Lias below. They have however usually been described collectively as the Northampton Sand, a term not very appropriate to the series as a whole.

---

[1] "The Junction Beds of the Upper Lias and Inferior Oolite in Northamptonshire," by Beeby Thompson, *Journal Northamptonsh. Natural History Society.*, vol. xi., pp. 202, 237, 241; vol. xii., p. 55.

Three main divisions are recognisable in some districts, but mostly only two are developed. The character and maximum thicknesses of each division are given below :—

	Maximum thickness in feet.
3. LOWER ESTUARINE BEDS. White, bluish, or ruddy sands with argillaceous matter or actual clays in places, and vertical plant-markings usually present.	15
2. VARIABLE BEDS.—Calcareous or sandy beds; sometimes slaty, sometimes a ferruginous building-stone.	30
1. IRONSTONE BEDS.—Rich red or brown iron ore (limonite); green or grey carbonate of iron; red sandstone, or calcareous beds (sometimes).	30

Over the greater part of Northamptonshire where iron-ore is worked, divisions 1 and 3 only are recognisable, and the thickness is less than one-third of the maximum recorded for all three divisions. The most common development would probably be about 5 feet of white sands and 9 feet of workable ironstone.

The Variable beds are only developed to a noticeable extent within a few miles around Northampton.

As elsewhere remarked, "The Northampton Sand is usually very porous throughout, and when its junction with the underlying impervious [Upper Lias] clay was first exposed by denudation, in the early stages of valley formation, water would run from it almost anywhere along that line; but some particular places being slightly more favourable than the average for discharging it, gradually monopolised the water from an increasingly large area up to a certain limit."[1]

Thus distinct springs occur at various points along the junction of the Northampton beds and Upper Lias.

Moreover, the Northampton Sands in certain areas as observed by W. T. Aveline "do not lie flat on the tops of the hills, but cover them like a saddle, every ridge being an anticlinal axis, and every brook running on a synclinal axis."[2]

This dip toward the valleys, though it may to some extent be due to flexures, has been in all cases much accentuated by downwash and undercutting of the Lias clay by springs. Indeed the features described by Aveline are mainly due to slips and downwash; and the deceptive junctions caused by these processes have suggested unconformity between the Upper Lias and Northampton Sands, of which there is little or no evidence in the undisturbed strata.[3]

As a water-bearing formation "The Northampton Sand yields abundance of good water from hundreds of springs and wells, but superficiality and consequent weathering of the rock seem to be necessities for quantity and good quality. As a deep-seated source of water it is decidedly a failure, for in easterly districts where it has been pierced at a good depth, water is absent or small in quantity (Peterborough), or highly sulphurous, emitting an offensive odour of sulphuretted hydrogen (Raunds, &c.)."[1]

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[1] "Vict. History of Northamptonshire," *Article* "*Geology*," p. 31.

[2] Geol. parts of Northamptonshire and Warwickshire (*Mem. Geol. Survey*), 1861, p. 8.

[3] Thompson, *Journ. Northampton Nat. Hist. Soc.*, ix., pp. 131, 212, and Plate V. p. 214.

In Bedfordshire, as noted by Mr. Woodward, occasional hard bands have been encountered in well-borings that may be referred to the Northampton beds, but there is no mass of these strata in the county that would yield any useful supply of water.

The reservoir for the water-supply of Northampton, in the valley between Teeton and Ravensthorpe, is fed by springs from the Northampton Sands as well as by direct rainfall; and the same remark applies to the reservoir for the water-supply of Kettering, situated in the valleys on each side of the ridge of land on which Thorpe Malsor stands; and to the reservoir for the water-supply of Rushden and Higham Ferrers, situated near to Sywell.

The water usually comes from the lowest beds only, for reasons already given, but exceptionally the Lower Estuarine Sands yield water (*cf.* Hardwick). B. T.

Lincolnshire Limestone.

This division consists of oolite, compact limestone with scattered grains of oolite, and of fossiliferous limestones that sometimes form layers of hard rag. The thickness of the formation varies from a few feet to about 80 feet in north Northamptonshire.

It becomes attenuated on the borders of Huntingdonshire, at Wansford, and east of Sutton and Castor, and is not present below Milton Park and Peterborough.[2] It also thins out south of Fotheringhay, being absent at Oundle. At Geddington it is but 12½ feet thick, and it thins out a few miles further south near Harrington and Maidwell. It is not present in Bedfordshire.

At the base of the Lincolnshire Limestone at Collyweston there is locally a sandy subdivision from 2 to 18 feet thick, which includes concretionary bands of calciferous sandstone and sandy limestone. These bands are sometimes fissile, and in this condition they have been utilized for roofing purposes under the name of Collyweston Slate, at Collyweston, Easton, and Dene (including Kirby).

As a water-bearing formation the Lincolnshire limestone is of great importance. In parts of Lincolnshire, notably at Bourn, the supply has been very considerable. In Northamptonshire, north of Peterborough, good supplies have been obtained. Thus, at Werrington an overflowing spring was tapped at a depth of 132 feet and yielded a supply of 300,000 gallons per diem.

Elsewhere in the northern part of the county the yield of water is subject to much variation, owing in part to the variation in thickness of the strata, and to the fact that they are much covered by a mantle of Boulder clay.

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[1] "Vict. Hist. of Northamptonshire," p. 38.

[2] Judd, Geology of Rutland, *Mem. Geol. Survey.* pp. 100, 143, &c.

GREAT OOLITE SERIES.

This series is divided, in descending order, as follows :—

Great Oolite Clay.
Great Oolite Limestone.
Upper Estuarine Series.

Upper Estuarine Series.

This series consists of blue, purple, white and variegated clays with sandy layers, and occasional bands of limestone, and oyster-beds, with also pyrites, selenite, fibrous carbonate of lime or "beef," calcareous concretions known as "race," and lignite. At the base there is usually a band of nodular ironstone.

The thickness varies from about 15 to 44 feet (*cf.* Brigstock). Near Northampton and near Bedford it is about 27 feet.

Notwithstanding the variable character of this set of beds, and the presence of thin bands of limestone at different horizons, there is one limestone bed which is remarkably persistent over a very large area, and which is important inasmuch as it commonly yields water; this bed Mr. Beeby Thompson has named the Upper Estuarine Limestone. (*Cf.* Moulton Park, Pytchley, Wilby, &c.)

Great Oolite Limestone

This consists of grey, white, and sometimes red or pinkish-coloured limestone and marls where long exposed at the surface; and of blue limestone and marls where protected by a covering of clayey beds.

The following notes are by Mr. Beeby Thompson :—

The average thickness may be put at about 25 feet, and on the whole it shows comparatively little variation in thickness and general character over the area embraced by this memoir.

Where superficial it is not a very good water-bearing bed (there are exceptions), its capacity for water being essentially that of its numerous fissures, so that it is liable to give most abundant springs for a short period after rain, that is to say it quickly runs itself dry (*cf.* Abington). When deep-seated the above-named objection does not apply, but then the rock is likely to be much less fissured and so the amount of water available is more limited.

Its capacity to store and yield water is also at times somewhat interfered with by marly or argillaceous horizontal partings, and so water may be found at more than one horizon in the same limestone series, as at Great Doddington and Wollaston.

B.T.

The Holy Wells at Oundle and Barnwell St. Andrews derive their waters from the Great Oolite Limestone.

Along the borders of the Ouse Valley above Bedford numerous springs issue from the Great Oolite, and considerable quantities of water have been obtained from the formation in the town and neighbourhood.

Great Oolite Clay.

This sub-division comprises variegated, blue, green, yellow, purple and black clays, with irregular sandy, ferruginous and shelly bands, and occasionally a bed of limestone like Forest Marble. Selenite, layers of "beef," nodules of "race" and ironstone, and lignite are met with. Often a layer of ironstone nodules occurs at the base.

In thickness the Great Oolite Clay varies from a few feet in Bedfordshire to 10 or 20 feet in Northamptonshire.

Cornbrash.

This formation consists of pale grey and bluish-grey limestone and marl. The stone is sometimes sandy and fissile. Its average thickness is about 5 feet in Northamptonshire, although it attains to 15 feet at Peterborough. In the neighbourhood of Bedford it is but a foot or two. Where of sufficient thickness it has sometimes yielded limited supplies of good water.

Oxford Clay and Kellaways Beds.

The Oxford Clay consists of a mass of grey and greenish clays and shales with large cement-stones or septaria, selenite, pyrites, and lignite. Occasional bands of limestone are met with in the higher portions of the formation. The Oxford Clay merges downwards into the Kellaways Beds which comprise alternations of sandy clay, sandstone and sand, and usually dark grey clay 10 or 12 feet thick at the base. The sands are sometimes cemented by calcite into hard spheroidal "doggers." The thickness of this subdivision varies from about 10 to 50 feet; and that of the Oxford Clay is from 400 to 500 feet.

The Kellaways Beds yield water, but not as a rule of good quality. It is particularly saline in the area to the south and south-west of Bedford, where the strata are no doubt supplied to a large extent, through the gravel, with water from the Ouse valley.

Ampthill Clay.

The Ampthill Clay which represents the Corallian limestones, sands and calcareous grit of other parts of England, consists of grey marly shale and stiff clay with selenite, calcareous nodules, and occasional bands of limestone. The formation is from 40 to 60 feet thick. It is not to be regarded as water-bearing, although limited supplies for a cottage might locally be obtained in the basement stone-bed, which at Ampthill is between 4 and 5 feet thick. The formation is for the most part concealed beneath Cretaceous strata; and may occur directly below them, from Leighton Buzzard to Ampthill and Biggleswade.

Kimeridge Clay.

This formation consists for the most part of black clay or shale with occasional nodules and thin bands of limestone, and septaria. Selenite occurs, and in places the shales are bituminous. Black phosphatic nodules are usually met with at the base. The fossil shells which occur abundantly are sometimes iridescent, and often their compressed forms are conspicuously white.

The full thickness of the Kimeridge Clay in Midland regions is about 100 feet, but the formation is only present to a very limited extent in our district, near Ampthill in Bedfordshire, and to a thickness estimated at 10 feet.

CRETACEOUS.

Lower Greensand.

This formation, represented by the Woburn Sands, comprises a series of sands of various colours and degrees of coarseness, passing in places into sandstone, with occasional bands of clay, Fuller's earth, and also phosphatic nodules and pebbles as at Potton. The sandstone is sometimes a hard red rock (" carstone ") as near Sandy. Occasionally, as near Woburn, it is a hard green sandstone.

The thickness near Leighton Buzzard and Woburn is from about 170 to 280 feet.

Mr. A. C. G. Cameron has remarked that—

> "At Woburn, Beds, the Fuller's earth is obtained by digging cylindrical holes or wells, as they are called, in the Greensand, until this marl is reached. Sometimes there is water, oftener not; but when there is, it is the finest and sweetest in the country, very clear, never failing, but not very abundant. So good is it that those domestic wells deriving their supply from some other source than the Fuller's earth, are treated to it, from time to time artificially, by having masses of it placed in them."[1]

The following notes are by Mr. A. J. Jukes-Browne:—

Wherever the Woburn sands come to the surface or are overlain by Drift deposits a good supply of pure soft water is generally to be found by sinking an ordinary well. Sometimes, however, the water contains iron in solution and occasionally it is strongly chalybeate. The water found near the base of the sands at Heath, Woburn, Aspley Guise and Ampthill is singularly pure and free from iron. According to information obtained by Mr. A. C. G. Cameron from Dr. Garrett, out of samples from 21 wells in Ampthill only one contained iron and that only to the extent of one twentieth of a grain in the gallon. One at Mrs. Eagles, described as " supposed chalybeate," contained no iron, but the water was quite unfit to drink on account of contamination from the surroundings. The well at Houghton House (in ruins) contains more carbonate of lime than is found in other wells near Ampthill.

Water from wells at Heath only contains from 12 to 15 grains of solid matter per gallon, and a very small quantity of Chlorine. Well water at Leighton Buzzard is much less pure, containing from 50 to 73 grains of solids per gallon and sometimes as much as 13·8 of Chlorine (*see* Lewis' Geology of Leighton Buzzard).

A strongly chalybeate water issues from springs on Flitwick Moor, in the valley of the Flit, about a mile from Flitwick Station on the Midland Railway (*see* p. 47.)

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[1] *Geol. Mag.* 1885, pp. 91, 190.

Water from the Lower Greensand is also obtained in the area which lies to the south of its outcrop by boring through the Gault and in some cases through the Upper Greensand and Chalk Marl also. Water has been obtained from this source at many places near Tring, as for instance at Cheddington and at Ivinghoe in Buckinghamshire, and at several places along the course of the Grand Junction Canal.

In all such cases the water rises to a high level in the bore, and in the lower parts of the Gault plain it often overflows.

As remarked by Prof. E. J. Chapman in 1852, "In this valley, within an area of about ten square miles, from one to two hundred borings have been executed; and in a great number of instances the bore-holes produce an overflowing stream."

Silsoe, Barton-in-the-Clay, and other villages derive their water supply from this source, the water generally having a temperature of 51° F. and sometimes being slightly chalybeate.[1]

Wherever the coprolite beds in the Gault or at the base of the Chalk Marl have been worked, water for washing the nodules has been obtained on the spot by boring through the Gault to the Lower Greensand. A. J. J. B.

Gault.

This formation consists of dark grey clay and marl, with phosphatic nodules usually at or near the base, and also at other horizons. The lower portion is somewhat sandy near the base, but in mass it is more distinctly argillaceous, and less calcareous than the upper portion, which is lighter in tint.

The thickness of the Gault is from 150 to 300 feet. It is thicker in the south; thinner in the east. When Chalk Marl rests directly on the Gault, as between Barton and Shillington, there is a marked belt of clayey ground.

Upper Greensand.

The Upper Greensand is represented over a small area near Eaton Bray and Totternhoe, by about 20 feet of yellowish-grey micaceous sand and dark green glauconitic sand. This passes up into the Chalk Marl. The strata yield water, but the formation is in this respect of limited local importance.

CHALK.

Lower Chalk.

The Lower Chalk near Dunstable is estimated by Mr. Jukes-Browne to be about 200 feet thick. It comprises the following sub-divisions:—

Lower Chalk.
- Marl, with courses of hard white chalk (Belemnite Beds) 3 to 4 feet.
- Blocky White Chalk passing down into pale grey chalk, with, in places, brown and green-coated nodules; about 60 to 80 feet.
- Totternhoe Stone, a massive bedded calcareous sandy stone, with green-coated phosphatic nodules at base; 20 to 22 feet.
- Chalk Marl, grey marl, with occasional hard calcareous nodules and pyrites; and, at the base; greenish-grey sandy marl, with phosphatic nodules, Chloritic Marl; 70 to 80 feet.

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[1] *See* Chapman in *Phil. Mag.* ser. 2, vol. iv., 1852, p. 102.

The Totternhoe Stone is a water-bearing stratum, and many springs issue from it, as subsequently noted.

During the excavation of the extensive cutting at Chalton, north of Dunstable, the flow of water from the Lower Chalk was "so copious that, in driving a heading into the escarpment, the workmen had to wear miners' costume, as their clothing was in a state of constant saturation."[1]

Middle Chalk.

This sub-division consists of hard white chalk and nodular chalk, with thin layers of marl; and with scattered flints in the upper part. At the base there are bands of very hard nodular chalk, known as the MELBOURN ROCK, about 9 feet thick. The full thickness of the Middle Chalk is about 220 feet.

"Many springs formerly existed at the junction of the Lower with the Middle Chalk at Houghton Regis, Leagrave, Limbury, and Biscot, but they are now greatly reduced in number and volume."[2]

Upper Chalk.

The Upper Chalk consists of chalk with bands of flint-nodules. The full thickness is about 200 feet, but nowhere in the county of Bedfordshire is more than half this amount present.

The CHALK ROCK at the base consists of hard cream-coloured limestones with softer bands, and is from 10 to 15 feet thick. It contains hard green-coated nodules.

Water supply from the Chalk.[3]

By A. J. JUKES-BROWNE.

In this area there are two principal water-bearing horizons in the Chalk, and outside the Chalk escarpment, that is to say north of and below the outcrop of the Chalk Rock, wells usually have to be sunk down to the level of one of these water-bearing beds. These beds are the Totternhoe Stone and the Melbourn Rock.

The reason of this is that both these stone-beds are underlain by impervious marls, the Totternhoe Stone by the Chalk Marl and the Melbourn Rock by the marls of the *Actinocamax plenus* zone (Belemnite Beds). Strong springs are thrown out at intervals along the line of outcrop of both these beds.

The water which falls on the watershed of the Chalk and sinks into the ground, percolates downward till it reaches the base of the Middle Chalk, or rather till it reaches the subterranean reservoir, whose floor is the upper Belemnite Marl; some of it then flows southward, and some northward. That flowing northward is ultimately thrown out at the outcrop of the Melbourn Rock. A small quantity may find its way through the Belemnite Marls into the Lower Chalk, but the volume of water thrown out from the springs in the Totternhoe Stone must be principally derived from the rain absorbed by the basset-surface of the Lower Chalk between the outcrops of the Melbourn Rock and the Totternhoe Stone.

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[1] J. Hopkinson and J. Saunders, *Article* "*Geology,*" in "Vict. Hist. of Bedfordshire," 1904, p. 17.

[2] J. Hopkinson and J. Saunders, *Article* "*Geology,*" in "Vict. Hist. of Bedfordshire," i, p. 19.

[3] *See also* Jukes-Browne, "Cretaceous Rocks of Britain," vol. ii, pp. 184 462; and vol. iii, pp. 223, 425, &c.

The greater part of the water which falls on the high watersheds south and south-east of the Chalk escarpment passes southward, and sinking into the Chalk saturates portions of the Middle and Upper stages of the Chalk. The surface of this saturated portion of the Chalk is called the "saturation level," but it is not a horizontal plane, neither is its height or level at one place constant all the year round.

The saturation plane slopes to the south-east with the dip ot the strata, but at a much less inclination than this dip. Its slope is also less than that of the valleys which drain the country, so that it often happens that the slope of the valley intersects the plane of saturation, and water issues at the surface in the form of springs.

The variations in the level of the saturation plane depend on those of the rainfall. After wet seasons, or periods of heavy rainfall, the saturation plane gradually rises and springs appear at higher levels, that is higher up the valleys than usual. These form the nailbournes or winterbournes which occur occasionally in all Chalk tracts, and only flow for a limited period of time.

The upper portions of all the valleys, which commence at or near the Chalk escarpment, are dry in ordinary seasons, but there is always a place at which water constantly issues for many months in such seasons, the springs only running dry in the summer, or in times of drought. This place is generally indicated on the Geological Survey map as the point where alluvium first occurs in any valley, and it is generally regarded as the source of the stream in that valley. A. J. J. B.

With regard to the absorbent power of Chalk Prof. E. J. Chapman ascertained that Chalk from Luton absorbed water to the extent of 14·94 per cent. The mean of results of experiments on Chalk from several localities "gives 16·83 for the amount of water absorbed by 100 parts of Chalk, corresponding to rather more than 2½ gallons per cubic foot, or to very nearly 215 millions of gallons per square mile of one yard in thickness."[1]

EOCENE.

Reading Beds.

This formation is represented only by outliers of mottled clay loam and sand, about 10 feet in thickness, in southern Bedfordshire, at Caddington, Kensworth, Studham and Ringsall.

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[1] *Phil. Mag.*, ser. 4., vol. vi, 1853, p. 118.

PLEISTOCENE AND RECENT.

Clay with Flints.

This term has been applied to a mixed accumulation on the Chalk tracts, of reddish-brown clay with unrolled flints, commingled with sand, pebbly gravel, &c.

The true " clay with flints " is a residual product, a thin layer of reddish-brown ferruginous clay with unworn flints that lines the irregular cavities or pipes in the Chalk due to the dissolution of the limestone. Intermingled in these pipes is much Eocene débris, clays, sands and pebble-beds belonging to the Reading Beds, together with Glacial Drift. Much of the Eocene material may have been reconstructed during the Glacial period, and was then incorporated with the Drift.

The thickness varies from a few feet to 20 feet and more.

Glacial Drift.

Under this heading are included :—

Boulder Clay
Glacial sand, gravel, and loam.

The Boulder Clay is for the most part a stiff bluish-grey clay with much chalk and many flints, unworn or broken and partially worn, some subangular, and others in the form of flint-pebbles : the fragments of hard chalk are much glaciated. This is also the case with erratic blocks of other hard limestones. The Boulder Clay in fact contains many fragments and boulders derived from stratified and igneous rocks from a distance, and occasionally large transported masses of strata, as near Biggleswade (p. 39). In thickness this Drift varies from a foot or two to more than 100 feet.

Locally beds of sand and gravel are intercalated in the Boulder Clay, and they may yield limited supplies of water suitable for cottages. Elsewhere ponds have in some cases furnished the principal sources of supply, especially where Boulder Clay rests on Oxford Clay.

Glacial sand and gravel occur below much of the Boulder Clay and may be present to a thickness of from 20 to 40 feet.

Loam or brickearth occurs on the Chalk uplands as at Caddington.

In some parts of the Eastern counties in the area covered by Boulder Clay, deep valleys filled with Drift have been proved by well-borings, thereby upsetting calculations with regard to water supply.

Mr. Beeby Thompson has pointed out that " A buried valley near Northampton extends from the Wellingborough Road to the Billing Road, under Abington Abbey, and evidently debouched into the Nene. The trough is some 200 yards wide, depth unknown, and is filled with a jumble of materials not greatly water-worn, none being older than the Northampton Sand. On the Wellingborough Road Great Oolite limestone largely preponderates ; on the Billing Road there is more clay, and Kimeridge Clay fossils are rather abundant, "At Furtho, towards Stony Stratford, an old valley of the Ouse has in its midst Boulder Clay to a thickness of 100 feet or more (?) which the small post-glacial streams have not been able to remove"[1] (*cf.* Passenham).

Valley Drift.

This includes the older deposits of river gravel and occasionally of loam. The gravel is sometimes cemented into a conglomerate. The deposits attain in places a thickness of 30 or 35 feet, but are usually much less. Much of the gravel contains pebbles of limestone, and the water yielded is somewhat hard. In Northamptonshire, according to Mr. B. Thompson, "The River Gravel holds a vast quantity of water, and but for its usually polluted condition, partly because stagnant as an underground lake, and partly from particular pollution from various sewage farms along the Nene Valley, would be a valuable source of water."[2] (*cf.* Raunds Well.)

In the areas of Fenland there is also some estuarine and marine gravel.

Under the heading of Alluvium are included the later valley deposits which form the flat ground bordering the rivers and extend over wider areas in the Bedford Level. They include clay, sandy clay, silt, gravel, and peat, usually not more than 10 or 15 feet thick in the areas under consideration.

In the Fenland area some of the ground is below highwater-mark.

Mr. Cameron remarks that large expanses of Alluvium below Bedford are for the most part under water during the winter season. Considerable floods also occur from time to time along the Ouse above Bedford. At Oakley Bridge there is a flood-mark 6 feet above the floor of the bridge; date November, 1823. The ordinary summer flow of the river is nearly 20 feet below this mark. The Nene Valley is similarly subject to floods.

With regard to the agricultural characters of the two counties, the following Statistics taken from the Returns of the Board of Agriculture and Fisheries (vol. xlii, 1907, part 1, pp. 26, 34) may prove useful :—

——	Bedford.		Northampton.	
Total Area - - - -	301,829 acres.		636,123 acres.	
	1906.	1907.	1906.	1907.
Total Acreage under Crops and Grass - - - - - -	256,680	256,305	560,656	560,342
Arable Land - - - - -	147,500	147,867	192,529	192,655
Permanent Grass - - - -	109,180	108,438	368,127	367,687

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[1] *Journ. Northampt. Nat. Hist. Soc.*, vol. ix, p. 47, 1896; and "Vict. Hist. of Northamptonshire," *Article* "*Geology*," p. 28.

[2] "Vict. Hist. of Northamptonshire," *Article* "*Geology*," p. 38.

THE RAINFALL OF BEDFORDSHIRE AND NORTHAMPTONSHIRE.

By Hugh Robert Mill, D.Sc., LL.D.

(Director of the British Rainfall Organization).

1. Bedfordshire.

The accompanying map represents the distribution of average annual rainfall in Bedfordshire for the period of thirty-five years 1868–1902, that period being selected for the sake of uniformity with the rainfall maps accompanying earlier Water Supply memoirs. It affords a very close approximation to the average rainfall for a much longer period and for all practical purposes may be accepted as the true average.

The data were collected by the late Mr. G. J. Symons and his successors in the direction of the British Rainfall Organization; they are the result of voluntary observations made by a large number of private observers who forwarded the data for publication in the annual volumes of "British Rainfall." Every record was examined critically and compared with records from surrounding stations before it was published, and any doubtful point was referred to the observer so that any mistakes which had been made were in most instances detected and rectified.

Many of the records were of short duration, and only a few extended through the whole period for which the averages are calculated. By taking advantage of the long continuous records in, or on the borders of, the county it was easy to correct the shorter records to the value they would have shown had they extended over the whole period. To facilitate this the rainfall of each year in each long record was calculated as a percentage of the average of the whole period. The mean of any number of years corresponding to the duration of a short record thus gives the percentage which the arithmetical mean of the annual rainfalls for the short period forms of the 35 years average. As the ratios differed somewhat in the case of the long records in different parts of the district four groups were formed, each the mean of two stations in or on the border of Bedfordshire, and one or another of these was used according to the position of the station yielding a short record which it was desired to correct to the true average.

Table I. gives the four grouped ratios and in the last column a combined ratio which may be taken as affording the nearest possible approach to the fluctuations of rainfall over the whole of Bedfordshire from year to year.

This column shows that for Bedfordshire the wettest year in the thirty-five was 1875, with an excess of 29 per cent., though 1872, which was the wettest year of the nineteenth century in most parts of the British Isles, showed an excess of 28 per cent., which is a difference of no importance. It is worthy of notice, however, that in 1903, outside the period for which the average is calculated, the percentage of the average rainfall 1868–1902 was 136, thus showing an excess of 36 per cent. and making 1903 the wettest year on record for Bedfordshire. The driest year was 1870, when the rainfall was 73 per cent. of the average—*i.e.*, a deficiency of 27 per cent.; but 1887, which was the driest year on record in most parts of the British Isles, was practically equal, with a percentage of 74, corresponding to a deficiency of 26 per cent. The average of the three driest consecutive years was on two occasions 87 per cent. of the average; these were the years 1869–71 and 1900–02. On both occasions, it may be noted, the three driest years were followed by one of the wettest. With the exception of 1884, which was very dry, the twelve years 1875–1886 all had rainfall above the average, and with the exception of 1894, 1896 and 1900, which were at or within 5 per cent of the average, the eleven years 1892–1902 were all below the average. The greatest contrast is to be found between the mean of the nine consecutive wet years 1875–1883, which was 118 per cent. of the average, and the mean of the eight consecutive years 1895–1902, which was only 91 per cent of the average.

The figures from which the rainfall map has been compiled were derived from thirty-eight stations in Bedfordshire the record of each of which, whatever its length, was reduced to the average for thirty-five years and also corrected when necessary for the height of the rain gauge above ground. The last correction was fortunately required in very few instances, as nearly all the gauges were placed at the standard height of 1 foot above the ground; the correction when applied amounts to an addition of 1 per cent. to the recorded total for every additional foot of height.

The stations at which rainfall was observed were not distributed uniformly over the county; but considering the purely voluntary character of the work it is remarkable to find how nearly regular the distribution is, and the neighbouring counties supplied additional data which were found very useful. The range of average annual rainfall was sufficient to allow isohyetal lines (*i.e.*, lines of equal rainfall) to be drawn only for 27·5, 25·0 and 22·5 inches, and the smallness of this range makes it the less easy to draw the lines with confidence as to minor inflections. The map is, however, as accurate as the data and its scale permit and it may be relied upon for all practical purposes involving rainfall.

The following Table shows the area occupied by each zone of 2½ inches of rainfall, with the general rainfall of the respective zones:—

Zone.	Square Miles.	Per cent. of Total Area.	General Rainfall of Zone.
Below 22·5 in. - - -	65·5	13·8	21·80
22·5–25·0 in. - - -	263·6	55·8	23·90
25·0–27·5 in. - - -	89·0	18·8	25·85
Above 27·5 in. - - -	54·9	11·6	27·75
Total - - -	473·0	100·0	—

From these values the general average rainfall of the whole county is deduced as 24·43 in., or to the nearest quarter-inch 24½ inches; and applying the mean ratios for various years and groups of years from Table I. we get:—

1868–1902	Average General Rainfall of Bedfordshire - -	24·43 in.
1903	Maximum General Rainfall of Bedfordshire - -	33·22 in.
1870	Minimum General Rainfall of Bedfordshire - -	17·83 in.
1869–1871 1900–1902	Driest three years General Rainfall of Bedfordshire	21·25 in.

Except for the general fall of the land from south-west to north-east, from the slopes of the Chalk Hills to the valley of the Ouse, the configuration of Bedfordshire does not show any feature sufficiently well marked to exercise a powerful influence on the distribution of rainfall, though there is no doubt that a closer network of observing stations would bring out numerous coincidences between the form and height of land and the distribution of average rainfall, thereby enriching the detail of the isohyetal lines. As drawn, however, they clearly show the highest rainfall on the high land of the Chalk in the neighbourhood of Dunstable in the south-west, and the lowest rainfall in the low flat valley of the Ouse below Bedford in the north-east. The small area with more than 25 inches shown in the north, near Souldrop, has probably a fall very little above the limit which allowed the line to be drawn. Similarly, the narrow tongue of low rainfall south of Shefford is scarcely drier that the limiting line of 22·5 in. Taken as a whole Bedfordshire has a remarkably uniform rainfall, and the difference between dryness and moisture in the land depends far more on the variations in the permeability of the soil than on difference in local rainfall.

The somewhat unusual differences in the relative dryness or wetness of the same year in different parts of the county, already referred to when speaking of the ratios to the long period average, is probably to be explained by the comparative frequency of thunderstorms, of considerable intensity but small extent, in the summer months.

Table II. gives particulars of the average rainfall at fourteen stations, selected so as to give a fairly uniform representation of all parts of the county, and Table III. gives the monthly rainfall at three stations where the records are long and trustworthy. These are given both in the form of depth of rain and percentage of the annual fall occurring in each month, the mean of the latter in the last column may be taken as representative of Bedfordshire as a whole. On the average the driest month is seen to be March, the wettest, as in almost all parts of England, October. Next in wetness come July and August, the heavy falls of these months being explained by the frequency of thunderstorms. The wettest month in the whole period considered was October, 1891, when 8·31 in. were registered at Kensworth, and the maximum was recorded at each of the stations examined. The driest month was February, 1891, when no rain at all was recorded at Aspley Guise and only a few hundredths of an inch at any station in the county.

TABLE I.—RATIO OF EACH YEAR TO THE AVERAGE.

Year.	Southern Group —Kensworth and Hitchin.	Eastern Group —Waresley and Abington Pigotts.	Western Group —Aspley Guise and Newport Pagnell.	Northern Group —Kettering and Wellingborough.	Mean Ratio for Bedfordshire.
1868	103	89	102	84	94
1869	88	103	101	99	98
1870	77	71	75	70	73
1871	88	89	94	85	89
1872	123	127	127	134	128
1873	92	91	86	82	88
1874	80	81	83	87	83
1875	119	122	136	139	129
1876	122	117	123	129	123
1877	122	119	111	110	115
1878	119	102	106	101	107
1879	116	121	118	112	117
1880	119	114	124	131	122
1881	105	105	110	123	111
1882	118	116	125	137	124
1883	103	100	114	133	113
1884	82	72	78	80	78
1885	114	104	111	117	111
1886	107	111	117	123	114
1887	73	76	74	74	74
1888	93	98	98	96	96
1889	106	109	93	99	102
1890	85	82	79	77	81
1891	117	126	120	121	121
1892	91	112	88	87	95
1893	87	92	78	78	84
1894	108	111	106	97	105
1895	106	101	94	82	96
1896	101	105	102	96	101
1897	94	100	102	98	98
1898	76	91	83	77	82
1899	96	87	82	83	87
1900	103	98	101	99	100
1901	85	83	83	85	84
1902	82	75	76	75	77

TABLE II.—MEAN RAINFALL OF BEDFORDSHIRE.

Station.	Height above.		Period of Observation.	Number of Years.	Arithmetical Mean.	Computed Mean 35 years 1868–1902.	Computed Mean connected for height above ground.
	Ground.	Sea Level.					
	ft. in.	ft.					
Kensworth	1 0	630	1868-1902	35	27·80	27·8	27·8
Luton, Pumping Station	1 0	343	1882-1902	21	24·97	25·9	25·9
Leighton Buzzard, The Cedars	1 0	300	1870-1877	8	28·37	27·3	27·3
Silsoe, Wrest Park	1 0	—	1872-1902	31	24·22	23 9	23·9
Aspley Guise, Oaklands	1 0	432	1871-1900	30	24·10	23·6	23·6
Stotfold, Three Counties Asylum	1 0	220	1868-1902	35	23·22	23·2	23·2
Ampthill	1 0	313	1877-1893	17	25·56	24·6	24·6
Biggleswade, Old Warden	1 2	90	1877-1902	26	24·40	24·4	24·4
Potton, Wrestlingworth	1 0	119	1873-1902	30	23·07	22·9	22·9
Bedford, Western Street	1 0	110	1869-1893	25	23·32	22·6	22·6
Turvey	1 6	—	1900-1901	2	20·84	23·4	23·4
Tempsford Hall	0 9	80	1873-1892	20	23·72	22·8	22·8
Milton Ernest	5 0	137	1878-1902	25	23·73	23·9	24·9
Sharnbrook, Colworth Gardens	2 0 0 8	250	1896-1905	10	22·55	25·2	25·2

TABLE III.—AVERAGE MONTHLY RAINFALL.

Months.	Kensworth.					Aspley Guise.				
	Mean Monthly Fall.	Maximum Fall.		Minimum Fall.		Mean Monthly Fall.	Maximum Fall.		Minimum Fall.	
	in.	in.	year.	in.	year.	in.	in.	year.	in.	year.
January	2·11	4·63	1877	·59	1880	1·78	3·74	1877	·41	1880
February	1·86	4·51	1900	·03	1891	1·53	4·06	1900	·00	1891
March	1·70	3·80	1896	·44	1893	1·43	2·77	1888	·14	1893
April	1·91	5·19	1878	·25	1870	1·51	3·29	1882	·16	1893
May	2·00	5·58	1878	·47	1884 1896	1·86	4·36	1886	·32	1895
June	2·06	5·34	1879	·24	1870	1·82	4·33	1879	·34	1895
July	2·77	6·86	1889	·21	1885	2·34	6·21	1880	·17	1885
August	2·67	5·80	1879	·58	1880	2·19	4·96	1878	·46	1880
September	2·45	6·19	1896	·53	1898	2·22	5·50	1871	·24	1900
October	3·16	8·31	1891	·84	1879	2·48	6·81	1891	·65	1888
November	2·75	5·75	1894	·45	1879	2·24	4·43	1894	·64	1901
December	2·48	5·85	1876	·62	1873	2·07	5·13	1876	·56	1879
Year	27·92	34·58	1877	19·57	1887	23·47	31·32	1875	16·65	1870

Table III.—Average Monthly Rainfall.—*continued.*

Months.	Stotfold (Three Counties Asylum).					Mean Monthly Fall expressed as percentages of Annual Mean.			
	Mean Monthly Fall.	Maximum Fall.		Minimum Fall.		Kensworth.	Aspley Guise.	Stotfold.	Mean.
	in.	in.	year.	in.	year.	in.	in.	in.	in.
January	1·68	3·25	1877	·30	1880	7·5	7·6	7·2	7·4
February	1·48	4·04	1900	·03	1891	6·7	6·5	6·4	6·6
March	1·43	3·90	1897	·26	1893	6·1	6·1	6·2	6·1
April	1·51	2·89	1899	·13	1893	6·8	6·4	6·5	6·6
May	1·83	4·42	1886	·39	1896	7·2	7·9	7·9	7·7
June	1·83	4·25	1879	·50	1868 1895	7·4	7·8	7·9	7·7
July	2·31	5·92	1875	·24	1885	9·9	10·0	9·9	9·9
August	2·37	6·11	1895	·41	1871	9·6	9·3	10·2	9·7
September	2·10	5·91	1896	·21	1898	8·8	9·5	9·0	9·1
October	2·52	6·56	1891	·52	1879	11·3	10·6	10·9	10·9
November	2·22	5·20	1894	·48	1871	9·8	9·5	9·6	9·6
December	1·94	4·83	1876	·41	1879	8·9	8·8	8·3	8·7
Year	23·22	30·06	1872	15·88	1870	100·0	100·0	100·0	100·0

2. NORTHAMPTONSHIRE.

The accompanying map represents the distribution of rain over Northamptonshire as the average of the thirty-five years' observations from 1868 to 1902. The data were collected for the most part by the late Mr. G. J. Symons, who founded the British Rainfall Organization, and they were published in *British Rainfall* from year to year. The study of rainfall in this county has been greatly stimulated by the efforts of the Northamptonshire Scientific Society and Field Club; but, as in most other parts of the country, the observations have been made almost entirely by private individuals for various purposes, and had it not been for the exertions of the editors of *British Rainfall* many of the records would never have been preserved or published. The number of records is smaller than could be wished, especially as the range of rainfall is small, and the isohyetals cannot be drawn with the same decision or minuteness as in a district with a greater range of rainfall or a simpler and more accentuated configuration; this, however, does not affect the accuracy of the determination of the average rainfall.

A sufficient number of long records fortunately exists to enable us to determine the fluctuations of rainfall from year to year and so to compute from the more numerous short records the equivalent value for the full period of thirty-five years. For this purpose the rainfall for each year at the stations with long records was calculated as percentages of the respective mean values, and the ratios so obtained were averaged in three groups representing the southern, the north-western or Rockingham Forest, and the eastern parts of the county. These grouped ratios are given in Table I. together with the mean of the three groups which may be taken as the closest possible approximation to the general fluctuations of the rainfall over the county as a whole. The first thing which strikes one in the Table is the fact that during the earlier half of the period the rainfall was much higher than in the later, no less than nine consecutive years, from 1875 to 1883, having been above the average with a mean excess of more than 21 per cent. In the later period eight consecutive years, 1892 to 1899, were at or below the average with a mean deficiency of 11 per cent. Such long spells of wet and dry years are by no means common. The wettest year in the record was, as in most parts of the country, 1872, when the rainfall exceeded the average by 35 per cent.; but 1875 was scarcely less wet. The year 1903, which is not included in the period under consideration, had an excess of 24 per cent. in Northamptonshire, and although the wettest on record in some parts of England it was drier here than 1872, 1875, 1876, 1880, or 1882.

The driest years in the thirty-five were 1870 and 1887, which had practically the same deficiency of about 29 per cent., and the driest three consecutive years were 1892–94, when the mean was 86 per cent. of the average, a deficiency of 14 per cent.

Altogether there were 60 records in Northamptonshire and 48 on the borders in other counties which were available for use in constructing the map; but as Northamptonshire is surrounded on every side by other counties the rainfall of which has not been discussed in equal detail the lines upon the map have not been extended beyond the county.

After being reduced to the same long period the values derived from rain gauges set more than 2 feet above the ground were corrected to their equivalent value for a gauge set at the standard height of 1 foot. The figures were then placed on a map on the scale of 4 miles to 1 inch and isohyetals or lines of equal rainfall drawn at intervals of 2·5 inches. The lowest values on the map published herewith, which is reduced from the original map, were just 22·5 inches in the neighbourhood of Peterborough in the extreme north-east. The highest values approach, if they do not actually exceed, 30·0 inches on the high ground in the west, so that the whole range of rainfall is only 7·5 inches and the only isohyetals which play an important part are those of 25·0 inches and of 27·5 inches. On account of this small range, and because many hundred square miles have a rainfall between 24·5 and 25·5 inches, the position of the isohyetals cannot be fixed nearly so definitely as was possible, for instance, in the map of Kent, but they are approximate enough for all practical purposes.

The following Table shows the area occupied by each zone of 2½ inches and the average rainfall in that zone:—

Zone.	Square Miles.	Per cent of Total Area.	Mean Rainfall of Zone.
Below 25·0 in. - - -	394	39·2	24·26 in.
25·0 to 27·5 in. - - -	397	39·5	26·00 in.
Above 27·5 in. - - -	214	21·3	28·22 in.
Total - - -	1,005	100·0	——

From this the average value of the general rainfall of the county is found to be 25·78 inches; but as there is a slight uncertainty as to the exact value it is better to take it merely to the nearest quarter of an inch and call it 25·75 in. Applying to this figure some of the ratios from Table I. we get for the mean and extreme general rainfalls the following:—

1868–1902	Mean general rainfall for Northamptonshire - -	25·75 in.
1872	Maximum general rainfall for Northamptonshire -	34·75 in.
1870 or 1887	Minimum general rainfall for Northamptonshire -	18·50 in.
1892–94	Driest 3 years general rainfall for Northamptonshire	22·25 in.

While in its broad features the distribution of rainfall shows a relation to configuration, being greater on the higher land and less on the lower, the vertical relief of the county in not sufficiently pronounced to produce any sharp contrasts of rainfall. The greatest difference that appears is between the valley of the Nen, below Northampton, which has less than 25 inches of rainfall, and in the north-east as little as 22·5 inches, and the Oolitic hills in the south-west, west and north-west of the county, which have more than 27·5 inches, and at one or two points almost 30 inches. The inland position of Northamptonshire is undoubtedly one of the causes of the comparatively uniform distribution of rainfall, as from whatever direction a rain-bearing wind blows it must necessarily pass over a large extent of land, and, when blowing from the south, south-west, west and north, over higher land than it meets with in the county itself.

A selection of the rainfall values from which the map was compiled is given in Table II., these being chosen so as to be representative and uniformly distributed.

The importance of considering the distribution of rainfall in time as well as in space is sufficient excuse for introducing Table III., which gives the mean monthly rainfall for 35 years, or nearly so, at three representative stations, and the percentage of the year's rain which fell in each month. The average of these percentages gives an excellent account of the average monthly rainfall of the county. The wettest month is seen to be October, with 10·6 per cent. of the annual fall, and next to it comes July, with 9·9 per cent. This double maximum is characteristic of inland situations where the influence of summer thunderstorms is considerable. The driest month is March, with 6·0 per cent. of the annual fall. The six months of the summer half year, April to September, account for 50·5 per cent. of the annual rainfall, the six months of the winter half year, October to March, for 49·5 per cent. The wettest six months, July to December, account for 57·2 per cent. of the annual rainfall.

TABLE I.—RATIO OF EACH YEAR TO THE AVERAGE.

Year.	Southern Division.	Rockingham Forest Division.	Eastern Division.	Mean for Northamptonshire.
1868	102	87	93	94
1869	102	96	105	101
1870	75	69	70	71
1871	91	91	90	91
1872	131	138	136	135
1873	90	85	90	88
1874	84	81	79	81
1875	137	138	128	134
1876	125	121	128	125
1877	117	108	112	112
1878	109	107	107	108
1879	115	106	117	113
1880	129	131	133	131
1881	114	115	119	116
1882	129	131	134	131
1883	115	123	127	122
1884	74	81	76	77
1885	109	107	115	110
1886	117	114	123	118
1887	75	71	69	72
1888	97	99	93	96
1889	93	99	108	100
1890	79	82	80	81
1891	114	110	110	111
1892	81	83	94	86
1893	75	80	76	77
1894	99	95	94	96
1895	89	86	88	88
1896	98	98	93	96
1897	108	100	92	100
1898	82	84	76	81
1899	85	92	87	88
1900	100	116	96	104
1901	83	92	84	86
1902	77	84	78	80

TABLE II.—MEAN RAINFALL—NORTHAMPTONSHIRE.

Station.	Height above			Period of Observation.	No. of Years.	Arithmetical Mean.	Computed Mean 35 years 1868-1902.	Computed Mean Corrected for height above ground.
	Ground.		Sea Level.					
	ft.	in.	ft.			in.	in.	in.
Brackley	1	0	425	1891-1902	12	24·67	27·1	27·1
Whittlebury	1	2	350	1882-1901	20	27·13	28·5	28·5
Thorpe Mandeville	1	0	530	1884-1900	17	25·67	27·7	27·7
Woodford Halse	1	6	488	1894-1900	7	25·49	27·1	27·1
Blisworth	5	0	325	1886-1902	17	23·98	26·3	27·3
Castle Ashby	1	0	263	1875-1902	28	25·34	24·7	24·7
Weedon Beck	4	0	265	1874-1883	10	30·35	25·8	26·6
Northampton, Gold St.	6	6	230	1869-1892	24	24·27	23·3	24·4
Pitsford, Sedgebrook	1	0	311	1875-1902	28	25·75	25·4	25·4
Wellingborough, Croyland Abbey	0	5	174	1868-1902	35	24·74	24·7	24·7
Watford Court	1	2	380	1894-1902	9	24·85	26·9	26·9
Ravensthorpe, Coton Mill	1	0	360	1886-1902	17	24·19	26·2	26·2
Hargrave	1	0	219	1877-1896	20	25·82	24.9	24·9
Hazelbeach	2	6	560	1885-1889 1891-1902	17	25·48	26·9	27·3
Kettering	1	3	300	1868-1902	35	25·39	25·4	25·4
Welford, Salford House	1	3	430	1891-1902	12	25·33	27·1	27·1
Aldwinkle St. Peter	0	11	175	1892-1902	11	21·70	25·3	25·3
Braybrooke	4	3	–	1868-1878	11	27·97	27.4	28·3
Oundle	4 3	6 4	105	1888-1902	15	20·95	23·6	24·6
Weldon Grange	1	0	342	1894-1902	9	22·83	24.3	24·3
Peterborough, Thorpe Hall	1	0	30	1889-1902	14	19·90	22·4	22·4
Easton-on-the-Hill	0	9	271	1838-1902	35	23·87	23·9	23·9
Maxey Vicarage	1	0	32	1882-1900	19	21·74	23·3	23·3

TABLE III.—MONTHLY RAINFALL—NORTHAMPTONSHIRE.

Months.	Easton Neston near Towcester.					Wellingborough, Croyland Abbey.				
	Mean Monthly Fall.	Maximum Fall.		Minimum Fall.		Mean Monthly Fall.	Maximum Fall.		Minimum Fall.	
	in.	in.	year.	in.	year.	in.	in.	year.	in.	year.
January -	2·15	4.74	1872	·35	1880	1·96	3·66	1877	·44	1880
February -	1·87	5·38	1900	·00	1891	1·73	4·65	1900	·06	1891
March -	1·66	3·84	1897	·04	1893	1·56	3·43	1876	·16	1893
April -	1·76	3·84	1882	·17	1893	1·75	5·36	1876	·28	1893
May -	1·95	4·86	1886	·30	1895 1896	1·87	4·84	1886	·19	1895
June -	1·97	5·40	1879	(·32)	1870	1·94	4·70	1883	·56	1889
July -	2·57	6·75	1875	·17	1868	2·49	7·06	1880	·11	1897
August -	2·38	4·85	1881	·50	1871 1899	2·25	4·38	1881	·51	1871
September	2·43	5 76	1876	·57	1888	2·26	5·28	1876	·43	1898
October -	2·97	7·74	1891	·34	1888	2·52	5·69	1891	·46	1888
November	2 63	4·92	1875	·90	1901	2·22	4·40	1875	·68	1901
December	2·45	5·30	1872	·55	1873	2·19	5·28	1876	·51	1873
Year -	26·79	36·72	1872	17·44	1902	24·74	36·16	1882	17·21	1870

Month.	Easton on the Hill, near Stamford.					Mean Monthly fall expressed as percentage of annual mean.			
	Mean Monthly Fall.	Maximum Fall.		Minimum Fall.		Easton Neston	Wellingboro'	Easton on the Hill.	Average.
	in.	in.	year.	in.	year.				
January -	1·71	3·97	1872	·32	1880	8·0	7·9	7·2	7·7
February -	1·58	3·16	1900	·04	1891	7·0	7·0	6·6	6·9
March -	1·32	2·81	1897	·25	1893	6·2	6·3	5·5	6·0
April -	1·73	4·05	1876	·33	1893	6·6	7·1	7·3	7·0
May -	1·92	5·24	1869	·46	1895 1896	7·3	7·6	8·0	7·6
June -	1·85	3·96	1875 1879	·32	1889	7·3	7·8	7·8	7·6
July -	2·39	6·96	1880	·16	1897	9 6	10·1	10·0	9·9
August -	2·22	5·01	1878	·67	1899	8·9	9·1	9·5	9·1
September -	2·25	5·65	1883	·38	1890	9·1	9·1	9·4	9·3
October -	2·53	6·05	1880	·35	1888	11·1	10·2	10·6	10·6
November -	2·24	3·89	1883	·63	1889	9·8	9·0	9·4	9·4
December -	2·13	5·72	1868	·41	1873 1890	9·1	8·8	8·9	8·9
Year -	23·87	34·49	1872	15·05	1887	100·0	100·0	100·0	100·0

WELLS AND BORINGS IN BEDFORDSHIRE.

Ampthill.

Geol. map 46 N.W. and N.E. One-inch map N.S. 203 and 220.
Six-inch map 21 S.E. N.E.

Communicated by Mr. Whitaker and Mr. Cameron (Nos. 1–9.)

The average depth of the Ampthill wells, of which there are some 200, is about 25 feet, the depth varying according to the height of the ground.

The town is now supplied with water from Clophill. (*See* p. 44.)

One-inch map N.S. 203.

1. Rectory, Church Hill, N. of the town. About 340 feet above Ordnance Datum. Six-inch map 21 S.E.

Water stands 2½ feet up.

Sand [Lower Greensand] to [Ampthill] clay and water, 70 feet.

2. Houghton Park, Gardener's House, N.E. of Ampthill Rectory. About 350 feet above Ordnance Datum.

Sunk 25 feet and bored 10 [through Boulder Clay] into stone [carstone]. No water.

3. Brickhill Pastures Farm, over a mile north-eastward from the church. 1892. 384 feet above Ordnance Datum. Six-inch map 21 N.E.

Made and communicated by Mr. J. Fuller, of Wootton Keeley.

		Thickness. Ft.	Depth. Ft.
[Glacial Drift.]	Clay, with chalk-stones or chalk	35	35
	Sand and rough gravel	4	39
	Rock, which had to be blasted [Cemented gravel]	12	51
	Running sand	10	61
	Hard concreted gravel	12	73
	Gravel sand and rubble	27	100

This well is remarkable for the great thickness of Drift which it shows.

One-inch map N.S. 220. Six-inch map 21 S.E.

4. Town Pump. At the meeting of the roads in the middle of the town. About 328 feet above Ordnance Datum.

Shaft of 9 feet diameter. Water trickles in slowly all round, but principally on the south; level 6½ feet up; unfit to drink (Feb. 1894).

Sand [Lower Greensand], to clay, 20 feet.

5. Dunstable Street. Mr. Sharper's, near the Baptist Chapel. About 326 feet above Ordnance Datum.

Made and communicated by Mr. Fuller, of Wootton.

[Lower Greensand.]	Red sand, with some rocky pieces, 39 feet.
	Running sand at the bottom.

Water stands 3 feet up.

6. Snowhill House, close to the high road eastward of the town (1884?) About 290 feet above Ordnance Datum.

Communicated by Mr. A. Ussher, Architect (Bedford), with further information from the well-sinker.

Water-level 16 feet down. Supply "gentle," drawn from the base of the sands.

Sands [Lower Greensand]	62	80
Black [Ampthill] clay	18	

7. Morris's Brewery In the yard, now built over; the site marked by an inscribed stone, some depth from present surface. About 330 feet above Ordnance Datum. About 1830.

From Mr. Green, of the Brewery.
Shaft 300 feet, boring 400 feet, total 700 feet. No water found.
The great quantity of clay dug out was burnt into bricks.
A tank here measures 30 x 20 x 40 feet (deep). Water stands 8 feet up in winter, but was lessening in 1892. The section was :—

Alternations of sand and sand-rock	25	30 ft.
Fossiliferous blue clay	5	

At a pump in the yard, a thickness of 28 feet of sand was found; in the Fermenting Store, 24 feet of sand to clay and water.

8. Nursery Garden, Maulden Road. E. of the town.

Lower Greensand	58	64 ft.
Clay	6	

9. Ampthill House. South of Church 1885. About 312 feet above Ordnance Datum.
Information from the well-sinker.
Water stands 7½ feet above the bottom.

Before deepening, in sand-rock [Lower Greensand]	17	22 ft.
After deepening [Lower Greensand and Ampthill clay]	5	

W. W. and A. C. G. C.

10. Joint Isolation Hospital.

From Gipsy Lane Spring.

Communicated by the Local Government Board.

	Ft.
Loam	1
Clay	5
Lower Greensand. White running sand	1½
	7½

11. Little Park Farm.

Trial borings in field to north of Farm and S. of Lodge Plantation, for suggested supply of Ampthill. Communicated by Mr. T. Hennell (Bedfordshire Mercury, March 20, 1897).

1. About 150 yards from N.E. corner of field.

		Ft.
Soil		1½
Lower Greensand.	White, red, black, and greenish sand; and one thin layer of clay at about 16 ft. from surface	18½
Ampthill Clay		4
		24

Water from sand at 2 ft. 6 in. from surface; yield about 3,000 gallons in 24 hours.

2. At side of wood, near N.E. corner of field.

	Ft.
Soil	1½
Lower Greensand.—Black sand with greenish grains	7½
Ampthill Clay	2
	11

Water found at 18 inches below surface; supply about 2 gallons per hour.

Arlesey.

Geol. map 46; One-inch map N.S. 221; Six-inch map 27 N.W.

Water in village from shallow wells.

1. Bury Farm, by the Coprolite works (W.W.).

To rock [? base of Gault] about 200 feet.

2. MINISTER'S HOUSE.

Information from Mr. J. Condor, of Baldock, well-sinker (A.J.J.B.).

Shaft 25 feet, the rest bored.

		Thickness.
Clunch [Chalk Marl]	about	30
Gault clay (a vein of coprolites about twelve feet from the base, as usual hereabouts)	about	200
Lower Greensand	,,	5
		235

3. THREE COUNTIES ASYLUM, STOTFOLD, S.E. of Arlesey, 1869.

233 feet above Ordnance Datum.
Shaft 100 feet, the rest bored.
Water rises into shaft. Yield 2,640 gallons an hour.
1st spring 127 feet down? *in dark sand and coprolites.* 2nd 139? 3rd 151.

Communicated by Mr. S. Hughes, C.E. to Mr. Whitaker. (Memoirs, vol. iv.)

			Thickness.	Depth.
	[Drift] Loam and sand		7	7
	Chalk (*see* remark below)		40	47
	Gault ,, ,,		284½	331½
Lower Greensand, 133½ feet.	Brown sand	[? base of Gault.]	1½	333
	Coprolite		2	335
	Green sand		1½	336½
	Conglomerate of phosphatic nodules, pyrites, &c.		5	341½
	Sandstone		34	375½
	Sand, brown when first brought up (wet), but when dry light-grey; very hard, with many fragments of iron-pyrites and fossil wood		89½	465

[There must be some mistake in regard to the thickness of the Gault, which is made too great. In the old well, dug to a depth of about 70 feet, in 1857, the bottom earth looked like Chalk Marl; but supposing the shaft to be all in that rock there would still be nearly 260 feet allowed for the Gault, and I should think that the bottom of the Chalk Marl is really shown by the first spring, leaving a thickness of 204½ feet for the Gault, (besides the top 10 feet classed by Mr. Hughes with the Lower Greensand), which agrees with that proved by the wells in the coprolite-works of the neighbourhood This would give a thickness of 120 feet to the Chalk-without-flints and Chalk Marl, which agrees pretty well with the geological mapping.—W.W.]

Aspley Guise.

With WOBURN SANDS.

Geol. map 46 N.W; One-inch map N.S. 220; Six-inch map 24 N.E.

Communicated by Mr. Cameron.

1. DUKE'S HEAD INN.

	Ft.
Lower Greensand	90

2. MOUNT PLEASANT, adjoining the Wheatsheaf Inn.

About 330 feet above Ordnance Datum.

	Ft.
Lower Greensand	50

3. PAYNES WELL, adjoining Woodcote Villa.

Made about 60 years ago, and communicated by Mr. J. Dolton, well-sinker.

	Ft.
[Lower Greensand] Sand	80

A seam of Fuller's Earth 61 feet down.

Some water came in on top of the 'earth,' but the main spring comes in at the bottom above Oxford clay. Water stands 4 or 5 feet.

4. WOODCOTE VILLA. About 390 feet above Ordnance Datum.

	Ft.
Lower Greensand	15 or 16

Well sunk to clay (? Fuller's Earth).

5. RUSSELL STREET, WOBURN SANDS, north end.

		Ft.
Lower Greensand	Sand	10
	Clay (? Fuller's Earth)	

6. WOBURN SANDS, south end of village.

Lower Greensand up to 84 feet proved, a seam of Fuller's Earth at 70 feet.

7. WOBURN SANDS CHURCH, well in orchard, N. side of. About 400 feet above Ordnance Datum.

Communicated by Mr. Dolton.

	Ft.
[Lower Greensand] Sand	30
Green sand	5
Water found on piercing hard green sand at bottom.	35

8. WOBURN SANDS.

Trial Shafts for Fuller's Earth, 1893, on property of H. Hoare, Esq.

Lower Greensand, dry yellow and grey sand with some rocky pieces 87 feet.

A vein of Fuller's Earth 13 inches thick was encountered at 30 feet from the surface.

This sinking left off in a "mild clay."

Water at base "boils up" through the sand at the rate of 12 gallons a minute.

9. ASPLEY HEATH, In cottage garden.

Ireland's Ground. About 1898.

	Ft.
[Lower Greensand] Sand with Fuller's Earth	35

Water level 31 feet down.

This well has been made 30 years, during which time, the water, which is justly reported as "beautifully" soft and pure, has remained constant.

10. ASPLEY HEATH, WOBURN SANDS.

Sunk 66 feet; the rest bored.

Well. Diameter of bricked shaft 5 feet to a depth of 30 feet, then reduced to 4 feet.

Communicated by Mr. A. C. Plater.

	No. 1.	Thickness. Ft.	Depth. Ft.
Lower Greensand	Sand	10	10
	Rocky sand	20	30
	Marl	4	34
	Sand and sand rock	66	100
	Sand	8	108
	Stone	2	110
	Sand	14	124
	Poor Fuller's Earth	6	130
	White Stone	1	131
Oxford Clay.	Blue clay	9	140
	do.	15	155

No. 2.

Well. Diameter Bricked Shaft 4 feet.

About 40 feet distant, and 12 feet lower down, a second shaft was sunk that encountered a spring at a depth of 116 feet at about the horizon of the Fuller's Earth in No. 1 shaft.

Yield about 50 gallons in 24 hours in March, 1897; the quantity somewhat increased in the following year.

11. THE KNOLL, ASPLEY HEATH.

Communicated by Mr. Dolton.

		Ft.
Lower Greensand	Sand and sandrock, 1st Spring	85
	,, ,, ,, 2nd ,,	17
		102

12. THE KNOLL STABLES, ASPLEY HEATH.

Communicated by Mr. Dolton.

		Ft.
Lower Greensand	Sandrock	60
	Fuller's Earth	2
	Sandrock	70
		132

13. HEATHER BANK, ASPLEY HEATH.

Lower Greensand. Sandrock - - - - - - - 30 feet.
Water comes in very slowly. A. C. G. C.

14. MALTING, WOBURN SANDS.

Communicated by Mr. J. Eunson to Mr. Whitaker.

Good supply of water at depth of 55 feet from Lower Greensand. Shaft 23 feet; the rest bored, 1884.

Astwick.

Geol. map 46; One-inch map 204; Six-inch map 23 S.E.

Near the CHURCH. About 140 feet above Ordnance Datum.

Information from Mr. J. Conder, well-sinker.

[Gault] Blue Clay	130 feet.
[Lower] Greensand	

A. J. J. B.

Barton-in-the-Clay.

Geol. map 46 N.E.; One-inch map 220; Six-inch map 26 S.W.

1. RECTORY, Well. About 230 feet above Ordnance Datum.

Chalk marl - - - - - - - - - - 20 feet.

Thin rock penetrated and water obtained.

Several springs issue from the base of the Totternhoe Stone, to the south of this village. One has been noted as a petrifying spring.

A. C. G. C.

2. COACH AND HORSES, ¼-mile N.W. of church. Well sunk 30 feet and bored 160 or 170 feet, through blue clay [Gault] to sand and water.

Information from Mr. L. Peck, well-sinker.

3. BROOKENDGREEN FARM.

Well sunk through marl, about 30 feet to water.

Information from Mr. Peck.

A. J. J. B.

Bedford.

Geol. map 52 S.E.; One-inch map N.S. 203; Six-inch map 11 S.E.

Since the year 1868 the town has been supplied from a large but shallow well or chamber excavated in the Great Oolite Limestone, alongside the river Ouse, to a depth of 17 feet below the ordinary river level; and from subsequent headings.

The well was sunk in 1867, by Mr. J. Lund, to a depth of 30 feet, and a boring was continued to a further depth of above 75 feet, as follows :—

1. Town Water Works, Bedford.

Close to the river Ouse, about a mile north of the town.

Communicated by Mr. John Lund, Borough Surveyor, 1867, to Mr. A. C. G. Cameron.

Well 30 feet ; the rest bored

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil		0	9	0	9
[Debris of Great Oolite Clay]	Yellowish clay	8	0	8	9
	Woody deposit [Lignite ?]	0	3	9	0
[Great Oolite]	Laminated limestone	8	6	17	6
	Calcareous bed	0	3	17	9
	Rock	6	0	23	9
	Close hard limestone	2	6	26	3
	Laminated calcareous matter	0	3	26	6
[Upper Estuarine Series]	Clay	9	0	35	6
	Hard rock	4	0	39	6
[Upper Lias.]	Clay	65	0	104	6
	Rock	1	0	105	6

The particulars above given differ in one respect from those recorded by De Rance (*Rep. Brit. Assoc.* for 1878) who gives the total depth as 100 feet.

The full thickness of the Great Oolite Limestone has been reckoned to be about 25 feet in the headings, including marl partings.

According to a report (dated 1883) by Mr. James Mansergh, “In 1870 an open cutting, 155 feet long, was made up the approach road to the works, and arched over, and from the rock in this cutting an additional supply of water was obtained.”

The yield of water in 1871 was about 260,000 gallons a day ; in 1873 the available supply did not exceed 190,000 gallons. “In 1874, the cutting under the road was extended 200 feet farther, and the total yield in August of that year was 259,000 gallons a day.”

Considerable fluctuations in the yield of water have been recorded, thus “In June, 1881, the underground supply was gauged to be 360,000, and in June, 1882, 310,000 gallons a day.”

Mr. Mansergh was of opinion that in dry years the supply would not be more than 250,000 gallons a day, and possibly less.”

A further heading subsequently constructed, as noted in a report (dated 1901) by Mr. G. F. Deacon, enabled a supply of 1,000,000 gallons of water to be obtained in 1900.

The headings existing in 1903 are described in a Report by Major H. Tulloch as follows : “The main tunnel, or heading, 270 yards long, starts from a point ten yards from the water's edge, and runs in an E.S.E. direction at right angles to the course of the river. The second heading, 154 yards long, branches off from the main one at a point 72 yards from the starting point of the latter, and takes a S.S.E. course.”

The water from the headings and well is pumped about 150 feet high to a storage reservoir situated on the hill to the east, and the quantity available in 1903, according to Major Tulloch's Report, was approximately 1,000,000 gallons a day. From 5 to 7 million gallons a week have been pumped.

A new well with heading has since been made to the south of the Pumping-station, and a considerable increase in the supply of water was reported.[1]

It is admitted that the rest water-level in the chamber and adits is that of the river-level, but it is clear that there is no direct communication with the river, otherwise the yield would have been practically inexhaustible.[2] As a matter of fact the water-level in the well is considerably reduced by pumping, and it is to be concluded that the river-bed is locally rendered water-tight by alluvial silt.

It was remarked by Mr. Mansergh that when pumping was carried on from the extended heading of 1874, the water was drained from a recently deepened well in the village of Clapham ; and that certain springs issuing from the foot of the slopes to the northward of the works have ceased to flow.

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[1] *Proc. Geol. Assoc.*, vol. xix, 1905, p. 143.

[2] The flow of the adjacent river was estimated by Mr. Mansergh to be from 40 to 125 millions of gallons a day.

It is evident from the amount of water obtained from the well and headings, and likewise from the amount obtained from wells in the northern part of Bedford, that a considerable quantity of water is transmitted through the joints and fissures of the Great Oolite Limestone, more than could be expected from the rainfall on the outcrop of that formation.

It is therefore safe to conclude that much water is obtained indirectly from the broad tracts of valley gravel between Bedford and Sharnbrook. There at any rate the underground stores of water are in all probability connected more or less directly with the water in the river apart from the rainfall on that area. Gravel rests directly on the Great Oolite Limestone.

H. B. W.

2. FRANKLIN'S WELL. On east side of high road to Clapham, near the stone quarry by the Waterworks.

Made in 1901. Communicated by Mr. Charles Franklin.

Height above Ordnance Datum 141 feet. Water Level 51 feet from surface. Yield 72,000 gallons a day.

	Thickness.		Depth.	
	Ft.	in.	Ft.	in.
Drift, Oxford Clay and Kellaways Beds	37	9	37	9
Cornbrash	2	3	40	0
Great Oolite Clay	6	0	46	0
Great Oolite Limestone	7	6	53	6

3. PARK WELL.

Sunk 38 feet 6 inches, the rest 12½ inch bore. 105 feet 10 inches above Ordnance Datum. Yield 34,000 gallons a day.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift.	Clay [? and sand] water	19	4	19	4
Kellaways Beds.	Rock	2	4	21	8
	Clay	0	5	22	1
Cornbrash.	Rock	1	0	23	1
Great Oolite Clay.	Clay	6	1	29	2
Great Oolite Limestone.	Rock	5	4	34	6
	Clay	0	3	34	9
	Rock	1	0	35	9
	Clay	0	8	36	5
	Rock	0	9	37	2
	Clay	0	6	37	8
	Rock	0	9	38	5
	Clay	0	1	38	6
	Rock with clay beds	11	1	49	7

4. NORTH PARK ROAD.

Near the Cemetery. Communicated by Mr. Charles Wells. 147 feet above Ordnance Datum.

Yield 6,000 gallons an hour; water level 57 feet from surface.

	Ft.	in.	Ft.	in.
Boulder Clay	47	6	47	6
Kellaways Beds: Sand Clay	8	6	56	0
Cornbrash	3	6	59	6
Great Oolite Clay	5	6	65	0
Great Oolite Limestone	9	0	65	9

5. CASTLE CLOSE BREWERY (Mr. Higgens). 1886.

This well commences with a large chamber 43 feet 3 inches deep. For 11 feet 2 inches the diameter is 18 feet, and the remainder is 16 feet across. The well is then continued by a boring to a further depth of 73 feet 9 inches, making a total of 117 feet. In 1887 a heading was driven, about 40 feet from the surface.

Sunk and communicated by Mr. S. Foster, contractor, Kempston, to Mr. A. C. G. Cameron.

		Thickness. Ft.	in.	Depth. Ft.	in.
Valley Drift.	Gravel and Sand	12	0	12	0
Great Oolite Series.	Clay	4	0	16	0
	Thick and thin bluish-grey limestone and clay	27	9	43	9
	Softer stone	3	0	46	9
	Hard white limestone	6	0	52	9
	Shelly limestone	4	0	56	9
Estuarine Series.	Black clay	6	6	63	3
	White sand	1	9	65	0
Upper Lias Clay.	Clay (with *Ammonites communis* at 107 feet)	42	0	107	0
	Clay	6	0	113	0
	Rock (very hard)	3	0	116	0
	Clay as before	1	0	117	0

6. Bedford Brewery, Lurke Street. 1896.

Communicated by Mr. F. C. Fuller to Mr. A. C. G. Cameron.

The average depth of water is 9 feet 6 inches. Yield over 2.000 gallons per day.

The Kellaways Beds yielded 4 feet of water in 12 hours ; from the Cornbrash at first there was 3 feet in 12 hours and then 4 feet 6 inches. From the Great Oolite about 8 feet in 18 hours.

		Thickness. Ft.	in.	Depth. Ft.	in.
Valley Gravel.	Top soil	3	0	3	0
	Gravel and clay	7	0	10	0
Kellaways Beds.	Clay	3	0	13	0
	Loamy clay and sand	7	0	20	0
Cornbrash.	Pendle	1	0	21	0
	Fossiliferous rock	2	0	23	0
Great Oolite Series.	Clay		6	23	0
	Fossiliferous limestone	2	0	25	6
	Shelly clay		6	26	0
	Limestone rock	3	0	29	0
	Mottled dark clay	1	0	30	0
	Limestone rock and springs	4	6	34	6

7. Lurke Brewery, Lurke Lane. 1880.

Communicated to Mr. A. C. G. Cameron, February 14th, 1898, by Messrs. Nash, Brewers.

Shaft 51 feet 9 inches, the rest bored. Water-level 37 feet 5 inches down. Yield 3,000 gallons in 7 hours.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Earth or soil	3	0	3	0
Kellaways Series, etc.	Mild clay	6	0	9	0
	Dark clay[1]	25	0	34	0
Great Oolite Series.	Limestone	7	9	41	9
	Clay	3	0	44	9
	Limestone	7	0	51	9
	Limestone	3	0	54	9

8. Horne Lane Brewery.

Communicated by Mr. Charles Wells to Mr. Cameron, 1885.

Water stands 7 feet from the surface.

Shaft about 40 feet, the rest bored.

		Thickness. Ft.	In.	Depth. Ft.	In.
	Earth	10	0	10	0
Valley Gravel	Gravel	6	0	16	0
	Sand	1	6	17	6

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[1] N.B.—It is possible that this may include the thin layer of Cornbrash and the Great Oolite Clay—H. B. W.

8. HORNE LANE BREWERY—*continued*

		Thickness.		Depth.	
		Ft.	In.	Ft.	In.
Oxford Clay and Great Oolite Series.	Clay	46	0	63	6
	Rock	2	0	65	6
	Clay with thin layers of rock	36	0	101	6
	Clay	3	6	105	0
	Limestone	2	3	107	3
Upper Lias	Clay	50	0	157	3
	Rock	11	0	168	3
	Clay	15	0	183	3

Previous to 1883 the gravel springs were cut off and prevented from entering the shaft, and after this a good supply was got at 40 feet. The greater part of the boring was made in Lias, but no useful quantity of water was thereby obtained.

This boring, according to different accounts was continued to depths of 274 feet 9 inches, or 314 feet, mostly in clay, with one or two bands of limestone.

9. BEDFORD STEAM LAUNDRY, Goldington Road. 1890.

An old well (30 feet) and boring.

Communicated by Mr. J. Costin, well-sinker, Kempston, to Mr. Cameron.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Kellaways Beds.	Yellow loam	7	0	7	0
	Dark clay	5	0	12	0
Great Oolite Series	Limestone	6	0	18	0
	Clay	4	0	22	0
	Limestone. To bottom of Old Well	8	0	30	0
	Limestone	5	0	35	0
	Limestone	5	0	40	0
	Looser sandy stone, shelly (in small fragments.) Water	0	3	40	3

10. BEDFORD STEAM LAUNDRY. 1897.

Adjoining the L.N.W. Railway at Southend.

Communicated by Messrs Ussher and Anthony, Architects, Bedford, to Mr. Cameron.

Shaft 26 feet; the rest bored.

The well commences with a shaft 9 feet in diameter to 20 feet depth. The shaft is then reduced to 4 feet diameter.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Undescribed (gravel over black clay)		26	0	26	0
Great Oolite Series.	Rock	6	0	32	0
	Clay	5	0	37	0
	Rock	5	0	42	0
	Clay	1	10	43	10
	Rock	4	2	48	0
	Clay	1	3	49	3
	Rock	4	0	53	3
	Clay	0	6	53	9
	Rock	1	4	55	1
	Clay	1	2	56	3
	Rock	0	6	56	9
	Clay	0	4	57	1
	Rock	0	5	57	6
	Clay	2	3	59	9
	Rock	1	0	60	9
Estuarine Series.	Greenish clay	6	4	67	1
	Rock	1	10	68	11
	Greenish clay	4	0	72	11
	Rock	4	0	76	11
Lias clay		14	0	90	11

11. COUNTY SCHOOL. 1886.

Communicated by Mr. T. G. Elger to Mr. Cameron.

A heading at 70 ft. depth. Yield 1,000 gallons a day. An analysis of the water was made in 1887 by Dr. Prior. In this analysis 86·5 grains of chloride of sodium (common salt) were reported in a gallon of water.

Water-level when not pumped, 21 ft. 5 in. down. 1887.

		Thickness. Ft.	in.	Depth. Ft.	in.
River gravel		8	0	8	0
Kellaways Beds.	Loamy sand and stone lumps	17	0	25	0
	Black clay	8	0	33	0
Cornbrash.	Limestone	1	0	34	0
	Clay		3	34	3
	Limestone	1	3	35	6
Great Oolite Clay		2	8	38	2
Great Oolite Limestone.	Limestone	10	0	48	2
	Clay		6	48	8
	Limestone	10	0	58	8
	Clay	3	4	62	0
	Limestone	8	0	70	0
Upper Estuarine Series.	Greenish sandy clay	1	0	71	0
	Limestone	1	2	72	2
	Greyish-blue sand		9	72	11
	White sand	1	0	73	11
	Hard and soft stone	3	0	76	11

Mr. Cameron notes that the thickness assigned to the Kellaways Beds may be too great, as the gravel and underlying strata were somewhat mixed at the junction.

Mr. Cameron also mentions that there was an old well 52 feet deep, and another 24 feet deep. The water from the latter was very hard.

12. NEW INN, KIMBOLTON ROAD, 1891.

Communicated by Mr. J. Fuller, well sinker, Kempston, to Mr. Cameron.

Watel-level 4 feet from surface.

	Feet.
Loam and yellow sand	6
Hard black clay	10½
Total	16½

13. Well at FENLAKE, close to Anchor Inn, on Cardington Road. Communicated to Mr. Cameron by Mr. Henman, Cardington, 1892.

Water stands 10 feet in well.

		Feet.
River Drift.	Gravel	2
Oxford Clay.	Shale with fossils	14
		16

14. BOWER STREET (Mr. Fullard's Nurseries).

Dug well, 11 feet, 3 inches, the rest bored, 1893.

Made by Mr. Golding, well sinker, Kempston, and communicated by Mr. Cameron. Yield about 3 gallons a minute.

		Ft.	in.
Oxford Clay		9	0
Great Oolite Series.	Limestone	1	6
	Soft clay	0	9
	Hard limestone	6	0
	Soft clay	1	0
	Hard limestone	1	0
	Total	19	3

15. TAVISTOCK STREET (Gladwin's Cycle Depôt).

Dug well, water-level 8 feet down.

Communicated by Mr. Cameron.

	Feet.
Clay about	10
Limestone and clay about	10

16. Borings between COX'S PITS, 1 mile S.W. of St. Paul's Church, and AUSTIN CANONS.

Made by Messrs. Docwra for Messrs. J B. and E. Birch.

Communicated by Mr. W. Whitaker.

No. 1. *Adjoining limestone-quarry (now filled in.)*

		Thickness. Ft.	in.	Depth. Ft.	in.
	Made ground	7	0	7	0
Great Oolite Limestone.	Rock	2	6	9	6
	Dark clay	0	6	10	0
	Rock	1	3	11	3
	Dark clay	0	9	12	0
	Rock	5	0	17	0
	Dark clay	1	0	18	0
	Rock	2	0	20	0

No. 2. *Opposite side of river, near Austin Canons* (*see* p. 52.)

		Thickness. Ft.	in.	Depth. Ft.	in.
River Gravel	Sandy Loam	2	6	2	6
	Gravel	3	0	5	6
Oxford clay and Kellaways Beds.	Blue clay	6	6	12	0
	Rock	5	6	17	6
	Light sand	2	6	20	0

No. 3. *8 chains North of No. 2.*

		Thickness. Ft.	in.	Depth. Ft.	in.
Oxford clay and Kellaways Beds.	Yellow clay	2	6	2	6
	Blue clay	5	6	8	0
	Rock	2	6	10	6
	Dark sand	0	9	11	3
	Rock	2	3	13	6
	Dark sand	0	9	14	3
	Rock	2	6	16	9
	Dark sand	1	0	17	9
	Rock	2	3	20	10

Biggleswade.

WATER WORKS by NEWSPRING FARM, 2 m. S.S.E. of Railway Station.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six-inch map 23 N.W.

Shaft 14 ft. 4 in. diameter.

Communicated by Mr. Henry Home, 1903 (*Quart. Journ. Geol. Soc.*, lix, p. 375).

Height above Ordnance Datum 171 feet. Water level 54 feet below surface.

Yield abundant, 710,000 to 790,000 gallons a day.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Soil	2	0	2	0
Glacial Drift.	Boulder clay	8	6	10	6
	Dark indigo-coloured clay with septaria. Transported mass of Ampthill clay	67	0	77	6
	Chalky boulder clay	6	0	83	6
	Fine silty clay, with chalk and a few boulders	10	6	94	0
Gault.	Disturbed gault clay	7	6	101	6
	Clay	7	6	109	0
Lower Greensand.	Sand	71	6	180	6

The outcrop of the Lower Greensand in this neighbourhood is mostly concealed by glacial drift and valley gravel, and through the latter a large amount of water in the Lower Greensand is no doubt derived—H. B. W.

Billington.

1. THE RECTORY. 2. S. OF THE VILLAGE.

Geol. map 46 S.E. ; One-inch map N.S. 220 ; Six-inch map 31 N.E.

1. Information given by the Rector. Sunk 70 feet through clay, the upper part full of chalk-stones, the lower a clean light blue clay. Water comes in at 50 feet down (possibly from the Gault coprolite bed).

2. On the lower ground south of Billington, dug 70 feet and bored 90 feet, through clay, finding a good supply of water in sand (Lower Greensand).

A. J. J. B.

Bletsoe.

BRICKYARD AT BOURNE END.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 7 N.E. About 200 feet above Ordnance Datum.

Juassic Rocks of Britain, Vol. iv, p. 451.

		Ft.	in.
Kellaways Beds.	Greenish and yellowish sand, concretionary in places - - - - - - - - - - - Grey and yellow clay - - - - - - -	5	0
Cornbrash.	Fissile sandy and calcareous layers with *Ostrea flabelloides* - - - - - - - -	1	6
	Tough grey and brown limestone (water) - -	1	3

H. B. W.

Blunham.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 12 S.E.

No public water supply. Shallow wells.

Well at the Lodge, west of village. About 112 feet above Ordnance Datum.

Chalky gravel 15 feet.

[Boulder clay] Blue clay and stones.

Bolnhurst.

Geol. map 52 S.E. ; One-inch map N.S. 186 ; Six-inch map 8 S.W.

Ponds on Boulder-clay have locally been used as sources of water-supply.

Bromham.

1. BROMHAM HOUSE. (W. H. Allen, Esq.)

Communicated by Mr. Cameron.

Geol. map One-inch N.S. 203 ; Six-inch map 11 S.W.

Sunk 53 ft. 2 ins. ; the rest bored. 1897.
No water found.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Turf - - - - - - -	0	10	0	10
	Surface Soil - - - - - - - -	2	0	2	10
Kellaways Beds.	Mild clay - - - - - - - -	6	0	8	10
	Dark clay - - - - - - - -	4	0	12	10
	Blue rock - - - - - - - -	7	0	19	10
Cornbrash.	Rock - - - - - - - - -	1	6	21	4
Great Oolite Clay.	Clay - - - - - - - - -	7	0	28	4
	Clay [with brachiopods] - - - - - -	0	10	29	2
Great Oolite Limestone.	Blue rock - - - - - - - -	24	0	53	2
Estuarine Series.	Blue clay - - - - - - - - -	10	0	63	2
	Rock - - - - - - - - - -	3	0	66	2
	Blue sand and clay - - - - - - -	0	6	66	8
	Rock - - - - - - - - -	2	0	68	8
	Blue sand - - - - - - - - -	2	0	70	8
	Blue rock passed through and the boring was carried to a further depth of about 30 feet, making a total of 100 feet below the surface.	29	4	100	0

2. BROMHAM VIADUCT, Midland Railway (about a third of a mile west of the Bedford Waterworks).

Trial holes. Communicated by the Assistant Engineer to Mr. A. C. G. Cameron. 1891.

A. South side of Viaduct, and close to south bank of River Ouse.

		Ft.	in.
	Made earth (dug)	4	0
Valley Drift, etc.	Light gravel and shaly rock	2	0
Great Oolite Limestone.	Limestone in layers	2	6
	Blue shale and clay	2	6
	Blue "fossil" limestone	2	0
	Blue clay	1	0
	Blue "fossil" rock[1]	2	0
	Total	16	0

B. 30 yards north of river.

		Ft.	in.
Alluvium	Silty clay	8	9
	Peat and clay	3	0
Valley Drift.	Flint gravel	3	1
Great Oolite Clay ?	Hard blue clay	1	2
	Total	16	0

C. 50 yards north of the last.

		Ft.	in.
Alluvium.	Silty clay	4	3
Valley Drift	Gravel	6	3
Cornbrash ?	Limestone (and water)	1	3
Great Oolite Clay ?	Blue clay	1	0
	Hard "fossil" blue clay	4	0
		16	9

Caddington.

Geol. map 46 S.E. ; One-inch map N.S 220 : Six-inch map 32 N.E.

Communicated by Mr. Cameron.

1. ZOUCHE'S FARM, to N.W. About 660 feet above Ordnance Datum.

Well 273 feet deep in Chalk.

2. CHAUL END. About 627 feet above Ordnance Datum.

Well 300 feet deep through Clay-with-flints into Chalk.

Campton.

Geol. map 46 N.E. ; One-inch map N.S. 221 ; Six-inch map 22 S.E.

About 145 feet above Ordnance Datum.

Water from shallow wells in Lower Greensand.

Cardington.

Geol. map One-inch N.S. 203 ; Six-inch map 17 N.W.

1. BREWERY. About 87 feet above Ordnance Datum.

Shaft 66 feet, the rest bored. 1885-91.

Communicated by Mr. C. Hickman.

		Ft.
Valley Gravel		10
Oxford Clay and Kellaways Beds	Shelly blue clay	50
	Sandy rock and sand with water	6
Cornbrash and Great Oolite Series	Alternations of limestone and clay	30
		96

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[1] No percolation of water.

2. COTTON END. Cottages adjoining the Bell Inn, and Herring's Green Farm House (same section). About 100 feet above Ordnanoe Datum.

Communicated by Mr. J. Hannam.

		Ft.
Oxford Clay		104
Kellaway Beds.	Sand	6
		110

Plenty of water was got from the sand and it stands 20 feet up in the well.

A. C. G. C.

Clapham.

Geol. map One-inch N.S. 203 ; Six-inch map 11 N.E.

Communicated by Mr Cameron.

1. TWINWOOD FARM, well to S.E.

275 feet above Ordnance Datum.

Through Boulder Clay to a depth of 50 feet or more. Not much water. [? in Kellaways Beds.]

2. Well 800 yards west of Church.

Water stands 2 feet in depth.

	Ft.
Great Oolite Limestone	10

3. SHEPPARD'S NURSERIES. 1890.

Dug 30 feet, the rest bored

		Ft.
River Drift	Loamy soil and Gravel	12
Great Oolite Limestone	Limestone	18
	do.	2
Upper Estuarine Series	Blue clay, with wood [lignite]	4
	Greenish clay	4
	Hard sandy rock	2½
	Greyish sandy clay	1
		43½

4. HOSPITAL about half a mile to north of CLAPHAM FOLLY, and close to the Kimbolton Road.

Well and Boring. 1899.

Communicated by Mr. Preston, Architect, Bedford.

Dug 45 feet, the rest bored.

		Ft.
Oxford Clay	Clay	18
Kellaways Beds	Sand and clay	22
Cornbrash and Great Oolite Clay	Rock and clay	5
Great Oolite Series	Rock	18
	Clay	7
	Rock	3
	Blue clay	5
	Stone	8
	Clay	3
	Total	89

5. Clapham Park (James Howard, Esq.) 1886.

Communicated by Mr. J. Costin, Well-sinker, Kempston.

About 220 feet above Ordnance Datum.

Shaft throughout. Water-level 95 feet down.

		Ft.
Boulder Clay	Chalk and clay	30
Oxford Clay	Slaty black clay	60
Kellaways Beds ? and Great Oolite Series	Rock	22
	Total	112

6. Clapham Park, at the Lodge.

		Ft.
Boulder Clay and Oxford Clay		50
[Kellaways Beds]	Sand-rock (a few feet).	

7. Trial-holes at the Clapham Viaduct in connection with the widening of the Midland Railway in 1891.

A. Noted by Mr. Cameron, in foundation for Viaduct, 1891.

		Ft.
Alluvium	Clay (sandy mud)	6
River Drift	Gravel and sand	2
Great Oolite Series	Clay and stone	6
	Total	14

B. C. D. Communicated by Mr. James Briggs, Engineers Office, Derby.

B. On Alluvium about a mile west of the village, and 50 yards south of River.

		Ft.
Alluvium	Silty clay	8½
River Gravel	Dirty gravel	1½
Great Oolite Limestone	Blue "Fossil" bed	5
	Limestone in thin layers	2
	Total	17

C. On Alluvium, close to River Ouse.

		Ft.
Alluvial Deposits and Great Oolite Clay ?	Silty clay	1¼
	Gravel	1
	Peat and clay	2
	Blue clay	11½
	Hard blue marl	5½
	Total	28¼

D. On Alluvium, at north bank of River.

		Feet.
Alluvium	Earth, soil and clay	1½
River Drift.	Gravel	6
Great Oolite Series.	Blue clay and layers of stone	2½
	Limestone	3
	Hard blue clay	1½
	Limestone rock (Full of water)	1½
	Total	16

Clifton.

Geol. map 46 N.E. One-inch map N.S. 204. Six-inch map 22 S.E.

1. Clifton Lock 1½ miles east of Shefford.

Made and communicated by Messrs. Easton & Anderson, 1892.

Water at 111 feet, with much foul gas. 7 gallons per minute. Stood 6 feet below surface.

		Ft.	Ft.
	Surface soil	5½	5½
Gault		11½	17

1. CLIFTON LOCK—*continued.*

		Ft.	Ft.
[Lower Greensand]	Sandstone (hard) Coarse sand Iron sand	55	72
	Sands	19	91
	Clean and sharp sands (water)	20	111
	Sands, much cleaner	2	113

2. Supply in village mostly obtained from shallow wells up to about 32 feet in depth. Supply insufficient in dry weather. (Dr. F. St. George Mivart, Report to Local Government Board, 1899).

This water has in part been derived from superficial deposits.

Clophill.

Geol. map 46 N.E.; One-inch N.S. 220; Six-inch map 22 S.W. About 3 furlongs east of parish church.

About 188 feet above Ordnance Datum.

Yield 115,564 gallons per 24 hours. Level of water about 162 feet above Ordnance Datum; after pumping, about 134 feet.

Communicated by the Local Government Board.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Vegetable Soil		2	0	2	0
[Lower Greensand.]	Sandstone rock	20	0	22	0
	Dark sandstone and ironstone	5	0	27	0
	Dark running sand	18	0	45	0
	Fine running sand	5	0	50	0
	Sand, pebbles and clay	2	6	52	6
	Fine dark grey running sand	10	6	63	0
	Hard blue clay	4	0	67	0
	Light grey running sand	11	0	78	0
	Black clay	14	0	92	0
	Dark greensand	13	0	105	0
	Hard greensand	0	8	105	8
	Dark greensand	15	2	120	10
Ampthill or Oxford Clay		1	0	121	10

Cockayne Hatley.

Geol. map 52 S.E.; One-inch map N.S. 204; Six-inch map 13 S.E.

MANSION. About 220 feet above Ordnance Datum.

Made and communicated by Messrs. Duke and Ockenden.

		Thickness. Ft.	Depth. Ft.
Drift		about 50	50
Gault		,, 80	130
Lower Greensand.	Sand with veins of clay and some fossils	,, 50	180
	Rock	,, 1	181
	Clay	,, 39	220

In 1897 it was reported by Dr. G. S. Buchanan "Most of the inhabitants of the village obtain water from a brick well, provided with bucket and windlass, placed in the front garden of one of the cottages. This well appears to be fed mainly by service water which finds its way through the more porous layers of glacial drift which overlie the Gault. The depth of the well is 40 feet. Other villagers obtain water from a pump at another house in Hatley. This pump serves an old brick well, which formerly yielded an uncertain supply, but which now receives additional water, brought in pipes from a small spring about a quarter of a mile to the east of the village. 'Great house' and rectory each possess a separate well, as do the out-lying farm houses."—Report to Local Government Board, March 2nd, 1897.

Dunstable.

1. Messrs. R. White & Sons.

Geol. map 46 S.W. ; One-inch map N.S. 220 ; Six-inch map 32 N.W.

Dug well to 12 by 6 feet, the rest bored.

Made and communicated by Messrs. C. Isler & Co. 1905.

Water-level 80 feet below surface in bore-tube. Supply moderate.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Chalk		89	0	89	0
Gault [? and some Chalk Marl]		354	6	443	6
Lower Greensand.	Sand	0	3	443	9
	Grey sandstone	0	3	444	0
	Light grey sandstone	23	6	467	6
	Dark clay (grey sandy)	12	0	479	6
	Sand and clay	1	6	481	0
	Light sand	5	0	486	0
	Sand and clay	5	0	491	0
	Light sand	5	0	496	0
	Sandstone	10	0	506	0
	Light sand	4	6	510	6
	Sandstone	1	0	511	6
	Light sand and sandstone	3	6	515	0
	Sandstone	8	0	523	0
	Light sand and sandstone	4	0	527	0
	Sandstone	1	0	528	0
	Light sand and sandstone	3	6	531	6
	Sandstone	5	9	537	3

2. Dunstable Gas and Water Works.

Made and communicated by Messrs. Isler & Co. 1901.

Lined with 40 feet of 13½ in. tubes ; top 10 feet below surface. Water-level 140 feet below surface.

Supply 25,000 to 40,000 gallons per day.

	Thickness.	Depth.
	Ft.	Ft.
Dug well	13	13
Hard chalk	23	36
Chalk	167	203
Gault	2	205

3. Waterworks, near L. & N.W. Railway Station.

Over 10,000 gallons an hour pumped without much effect on the water-level.

Information of well given to Mr. Jukes-Browne by the Engineer in charge, was as follows :—

	Ft.
Chalk, into hard rock [Totternhoe Stone]	77

The rock stands like masonry and the water issues from cracks between the blocks, the supply never failing.

A second shaft, 60 feet deep, particulars of which were communicated by Mr. A. F. Phillips to Mr. Whitaker, was made and connected by a gallery with the above well. A boring was made to the total depth of 155 feet :—

	Ft.
Chalk, the lower part very hard	140
Gault [? Chalk Marl]	15

4. Red Lion Inn, in centre of town.

About 480 feet above Ordnance Datum.

Well about 80 feet deep, and the water in July 1884 stood between 30 and 40 feet from the bottom.

Dunton.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six-inch map 18 S.E.
About 165 feet above Ordnance Datum.

Water from shallow wells (loam and Boulder clay on Gault).

Eaton Bray.

Geol. map 46 S.W. ; One-inch map N.S. 220 ; Six-inch map 31 N.E.
300 to 326 feet above Ordnance Datum.

In 1897 Dr. S. W. Wheaton reported to the Local Government Board that :—

"Water is found at a small distance from the surface in most parts of the village, and there are numerous dykes and open watercourses ; hence the site is naturally a damp one. The subsoil upon which the houses stand consists of chalk, rubble, sand, gravel and clay.

"*Water Supply.* This is obtained almost entirely from wells ; there are, in addition, two dipping places in the course of a spring, known as Pills, and water from streams passing through the place is used to a very small extent.

"There is no public water supply. The level of the water in the wells is subject to great fluctuations. At the time of my visit, in most of the wells water was standing within from 1 to 2 feet of the surface. In a few instances the water in the well was standing level with the surface of the ground, and one well was discharging a large quantity of water on the surface of the ground, a spring having risen in it. The wells are always dry-steined with blocks of hard chalk or with flints."

In 1904 a further report was made by Dr. R. Deane Sweeting, who then stated that, in all essentials, Dr. Wheaton's statements were still applicable. He observed that "a well about 20 feet deep was sunk in 1900 on waste land in the village of Eaton Bray by the Parish Council. A favourable analysis of this water having been obtained, it has continued in use, as well as that of the other shallow wells of the district."

Eaton Socon.

Geol. map 187 N.S. ; Six-inch maps 8 N.E. 9 N.W. S.W.
60 to 66 feet above Ordnance Datum.

In a report made to the Local Government Board in 1907 Dr. R. D. Sweeting remarked that water was dipped out of brooks in certain places in the parish of Eaton Socon. "At Staploe (Eaton Socon parish), though brook water is piped through a gravel bed to a well, the cottagers prefer to dip directly from the brook. In places, however, where pond and brook water is drunk, the inhabitants almost invariably boil it before drinking. And in a few others, where the wells are shallow and water stands near the surface, the cottagers prefer to collect rainwater in tanks or butts, and to boil and filter it before consuming it."

Part of the village of Eaton Socon has a public water-supply. "This is by the extension of the St. Neot's Urban District supply from that town to the nearest point of Eaton Socon village, viz., at Eaton Ford. There are five standpipes in the village. . . . The water is derived from a well 30 feet deep in the alluvial gravel of the Ouse. . . . But the greater part of Eaton Socon village is still dependent upon local wells. These are shallow surface wells as a rule, running very low in summer, and exposed at all times to pollution. . . . They are usually draw wells, but from some of them water is dipped."

Elstow.

Geol. map N.S. 203 ; Six-inch map 16 N.E.

1. N.W. of MEDBURY FARM.

About 100 feet above Ordnance Datum.

	Ft.
Gravel - - - - - - - - -	5
Blue (Oxford) clay - - - - - - -	4

2. Cow Meadow, ⅜ mile N.W. of RACEMEADOW FARM. 1873.

Communicated by Mr. Charles Howard.

Trial well dug on proposed site for Agricultural Show, to depth of "70 or 80 feet or perhaps more, all through clay with the exception of one or two seams of gravel of a few inches thickness."

A. C. G. C.

Everton.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 13 S.W.
225 feet above Ordnance Datum.

Wells 25 to 35 feet deep (Lower Greensand over Oxford Clay).

Eversholt.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 25 N.W.
360 to 370 feet above Ordnance Datum.

Water supply in 1884 from springs and shallow wells. (*See* Report by Dr. H. F. Parsons, to Local Government Board.)

Eyeworth.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six-inch map 18 S.W.

Water supply from shallow wells. Deficient in quantity. (Dr. F. St. George Mivart, Report to Local Government Board, 1899.)

Felmersham.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 7 S.W.
About 150 feet above Ordnance Datum.

Well dug 27 feet, the rest bored, about the year 1811, by Thomas Pain. (MS. of Rev. Mr. Marsh, in Bedford Library.)

	Ft.
Loam and gravel	17
Blue clay with band of rock 13 in. thick about 40 ft. from surface	40
	57

As remarked by Mr. Cameron the record is suggestive of the presence of the Estuarine Series and Upper Lias, beneath the Valley deposits.

Flitwick.

Geol. map 46 N.W. ; One inch map N.S. 220 ; Six-inch map 25 N.E.

1. Ampthill Water Supply.

Communicated by Mr. T. Hennell, Civil Engineer.

Trial well near Flitwick, September, 1897.

20 chains west of the church.

294 feet above Ordnance Datum. Water level 55 feet from surface.
Water supply full and free.

		Ft.
Lower Greensand.	Running sand	23
	Clay and sand in layers	4
Ampthill Clay.	Clay with a few hard layers	33
	Total	60

A few "flints" said to occur at depth of 23 feet.
No water found below depth of 27 feet.

2. Flitwick Hall (Major Brooks').

Communicated by Mr. Wilsher to Mr. Cameron, 1897.

Shaft 26 feet ; the rest bored.

		Ft.
Lower Greensand.	Sand, with water at depth of 10 feet	28
Ampthill Clay.	Blue Clay	34
		62

A ferruginous spring occurs on Flitwick Moor. (*See* p. 180.)

Goldington.

Geol. map N.S. 203 ; Six-inch map 12 S.W.

1. Howbury Hall. About 100 feet above Ordnance Datum.

Draw well in gravel tract to south of mansion, 18 feet deep.

2. Great Dairy Farm. 105 feet above Ordnance Datum.

Well through Boulder Clay and Oxford Clay 18 feet deep, with water [? from Kellaways Beds].

A. C. G. C.

Great Barford.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 12 N.E.

1. BIRCHFIELD FARM. About 105 feet above Ordnance Datum.

	Ft.
Boulder Clay	14
Oxford Clay	46

Spring at 60 feet.

2. WINDMILL, north of GREEN END. 127 feet above Ordnance Datum. Well dug 40 feet, bored 60 feet to rock [? Kellaways Beds]. No water.

3. In VILLAGE.

	Ft.
River Drift	10
Boulder Clay	31
	41

A. C. G. C.

Haynes.

(Hawnes.)

Geol. map N.S. 203. Six-inch map 22 N.W.

1. OXLEY'S FARM. About 370 feet above Ordnance Datum.

Well	Ft.
Chalky Boulder Clay	47
Lower Greensand with water	111
To Oxford Clay	158

2. WHITE HORSE INN, DEADMANS CROSS, about a mile north of Clophill.

Six-inch map 22 S.W.

Shaft 164 feet, the rest bored. Water stands 11 feet in well. Communicated by Mr. J. Fuller, well-sinker, Wootton.

		Ft.
Lower Greensand	Sand	70
	Sand rock	9
Oxford Clay	Clay	115
Kellaways Beds	Sand	—
		194

A. C. G. C.

Heath.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 28 N.W.
About 340 feet above Ordnance Datum.

HEATH AND REACH. Mr. Cameron's notes.

1. RED LION. Lower Greensand. Coprolites at 25 feet. Somewhat rocky at bottom. Clay [? Oxford], 29 feet.
2. The late MR. FOUNTAINE'S. Reported to be a great depth and to have yielded a mineral water, which would seem to have resulted from the decomposition of some shaly carbonaceous seam in the Oxford Clay.

3. 500 YARDS W. of MILETREE FARM.

		Ft.	in.
[Gault.]	Clay	6	0
[Lower Greensand.]	Ferruginous nodular bed	1	6
	Dark coloured pebbly sand	1	10
	Deep white sand (not bottomed)	–	–
		9	4

4. 300 yards E. of HEATH CHURCH.

Traces of Boulder Clay.

[Gault.] Clay, thick.

[Lower Greensand.] Coarse.
Yellow and orange-coloured sand.
Carstone, thick-bedded. Parts very compact and of a bright brick-red tint ; bluish-black in places.

5. OVERENDGREEN FARM. Six-inch map 28 N.E.

Made by Messrs. Mayne Bros., of Stewkley (well sinkers). Date 1870.

Communicated by Mr. Beeby Thompson, F.G.S., F.C.S., and Mr. John Chadwick, F.G.S.

Height above Ordnance Datum 464 feet ; Rest-level of water about 290 feet above Ordnance Datum.

This well has been abandoned for a shallower one because of the labour entailed in pumping from a depth of about 177 feet.

The following particulars are the best available :—

Water obtained from the Lower Greensand (sand and a few layers of sandstone).

Oxford Clay not reached in the well.

Water said to stand 8 to 10 feet.

A platform now exists at a depth of 156 feet=308 feet above Ordnance Datum, therefore the water is below this level.

A peculiarity of this well is that in stormy weather a pipe from it, as also the well itself, gives out a "trumpeting sound." On visiting the well in October, 1907, it was observed that there was quite a strong draught outwards through the two small ventilating holes in the wooden cover. Apparently the warmer air of the well is expelled by colder getting in from somewhere around.

Henlow.

Geol. map 46 N.E. ; One-inch map 221 ; Six-inch map 23 S.W.

About 160 feet above Ordnance Datum.

Wells in village mostly 25 to 30 feet deep.

THE BIRD IN HAND, by Station (near Stondon).

About 120 feet of mixed earth [? Drift]. Total depth over 200 feet.

W. W.

Holwell.

(Holywell of old map.)

Geol. map 46 N.E. ; One-inch map N.S. 221 ; Six-inch map 26 N.E.

1. HOLWELL BURY. 1905. Nearly a quarter mile E. of the house. Abandoned.

Made and communicated by Messrs. Docwra.

	Ft.	Ft.
Shaft (? old) the rest bored	—	49
Boulder Clay	49	98
Shingle, water-bearing[1]	4	102
Sand	19	121
Sandy Clay	12	133
Gault	177	310
Sandy Gault 8 in. and Gault 26 ft. 4 in.	27	337

2. Near the RECTORY, 1891.

From information given by Mr. J. Hopkinson on the spot.

Shaft 60 feet, the rest bored.

Water stands 19 feet in the well.

	Thickness Ft.	Depth. Ft.
[Drift] Sand and gravel	30	30
Chalk Marl	25	55
Gault	149 or 159	204 or 214
Lower Greensand	20 or 10	224

W. W.

---

[1] Water much impregnated with iron, is pumped to tank and allowed to settle (William Hill, 25th April, 1907).

Houghton Conquest.

Geol. map N. S. 203 ; Six-inch map 21 N.E.

152 to 165 feet above Ordnance Datum.

Wells 180 feet deep, through Oxford Clay into rock (Kellaway's Beds)

Houghton Regis.

SEWELL.

Geol. map 46 S.W. ; One-inch map N.S. 220 ; Six-inch map 32 N.W.

Boring made by L. & N. W. Railway at foot of Sewell Cutting, 1903.

About 400 feet above Ordnance Datum.

		Thickness. Ft.	Depth. Ft.
Chalk.	Chalk	70	70
Gault.	Hard blue clay	158	228
	Soft blue clay	42	270
	Hard blue clay	1	271
	Soft blue clay	61	332
	Dark blue clay	14	346
Lower Greensand.	Green sand	6	352
	Clay and sand	49	401
	Sandstone	76	477
	Green sand	50	527
Jurassic.	Blue clay	8	535
	Grey limestone	10	545

Husborne Crawley.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 24 N.E.

About 300 feet above Ordnance Datum.

Wells in the village usually from 20 to 30 feet, through Boulder Clay to Lower Greensand and water.

On the Green a well was dug through 30 feet of sand to green sand, with water ; this green sand is called "hard callous stuff." Information from the sinker, Mr. Dolton, as also the following.

At the White Horse Inn a thickness of 17 feet of sand was dug through to clay.

A. C. G. C.

Kempston.

Geol. map N.S. 203 ; Six-inch map 16 N.W.

1. BRICK YARD, WOOD END.

Sunk 30 feet : the rest bored.

	Ft.
[Oxford] Clay	50
[Kellaways] Sand	10
	60

Good supply of water.

2. Another well, on the south side of the main road, obtained water from 4 feet of gravel resting on Oxford Clay.

3. WOOD END (Miss Pedley's)

Communicated by Mr. J. Fuller. Water-level 50 feet from surface.

		Ft.
Oxford Clay and Kellaways Beds.	Mild Clay	15
	Black Clay	37
	Sand	7

4. WOOD END. On property of Mr. W. Ransom of Hitchin.

Information from Mr. S. Foster, Kempston.

Well dug about 40 feet and bored about 100 feet.

5. Cross Keys Inn, Wood End. (1890).

Made and communicated by Mr. J. Fuller, well-sinker, Wootton.

Dug 27 feet: the rest bored.

	Ft.
Oxford Clay	60
Kellaways Sand	5
Total	65

6. Little Dial Road, Kempston (Jesse Felt's).

Dug 27 feet, rest bored.

	Ft.
Oxford Clay	62
Kellaways Sand	5
Total	67

7. Another well in Little Dial Road.

Water stood 2 feet 6 inches in bottom of well.

	Ft.
Gravel	2
Oxford Clay (base of well)	22
„ „ (bored)	44
Kellaways Beds. Grey sand	5
	73

8. Meadow Farm.

Made by Messrs. Isler & Co. 1898.

Height above Ordnance Datum 200 feet.

Yield no good or useful quantity.

Bored throughout.

Communicated by Mr. Brocklehurst.

		Thickness. Ft.	Depth. Ft.
Oxford Clay		104	104
Kellaways	Sandy clay	19	123
Cornbrash	Stone	3	126
Great Oolite Clay.	Dark clay	7	133
Great Oolite Limestone.	Limestone	26	159
Estuarine Series.	Green clay	2	161
	Stone with marl	9	170
	Green clay	2	172
	Hard pyritous rock	1	173

9. "The Nest," Spring Road.

Communicated by Mr. Fuller, well-sinker, Keeley Lane, Wootton.

Water-level 8 feet down, 1894.

	Ft.
Red Loam	5
Sand	2½
Gravel	1½
Greenish clay	5
Total	14

10. Kempston Bury (W. G. Harter, Esq.).

Well, in Park south of House and adjoining the Bromham Road.

Communicated by Mr. S. Foster, Contractor, Kempston.

Dug well (1891).

		Ft.
Valley Drift.	Gravel	20

Very hard water.

Three trial bore-holes were made near the house. The strata consisted of Oxford Clay, about 30 feet, which rested on black sand. The water was of bad quality.

11. One and a quarter miles north of CHURCH END (Captain Beaumont's). 1891.

Communicated by Mr. Fuller, well-sinker, Wootton.

Dug 36 feet, the rest bored.

		Ft.	in.
Oxfordian and Great Oolite Series.	Clay	26	6
	Stone	10	0
	Clay and stone	15	0
	Soft sandy stone	1	6
	Stone	0	6
	Total	53	6

During the sinking of the above well, water issued with such great rapidity that further operations were suspended, as the workmen were not able to draw the water from the well.

12. At the LODGE, and at a somewhat higher level.

	Ft.
[Oxford] Clay	20
[Kellaways] Bright yellow Sand	3

In the well-sinker's opinion water from the sand-bed is often very good, but may soon become bad when pumping is discontinued.

13. KEMPSTON GRANGE (Mr. H. Howard's). 1890.

Made and communicated by Mr. J. Costin, well-sinker, Kempston.

Valley Drift and Kellaways Beds.	Mixed gravel and clay	15
	Black sand	5
		20

14. AUSTIN CANONS (Rev. Paul Wyatt). *See also* p. 39.

Made by Mr. J. Fuller, well-sinker, 1891.

Communicated by Mr. S. Foster, Kempston.

Shaft 17 feet 6 inches, the rest bored.

Yield no sufficient quantity, 1891.

		Thickness. Ft.
	Soil	1½
Valley Drift.	Gravel and water	4
	Black clay	1½
	Stone	2
Great Oolite Series.	Clay	1½
	Stone	1½
	Clay and stone	5½
	Clay and stone	15
		32½

15. MANOR HOUSE, in garden. Communicated by Mr. T. G. Elger, 1885.

		Ft.	in.	Ft.	in.
Valley Drift	Loamy soil	6	0	6	0
	Gravel (with much water)	8	6	14	6
Cornbrash? and Great Oolite Series.	Hard rock	1	2	15	8
	Blue clay	8	4	24	0
	Hard limestone	6	0	30	0
	Softer rock with iron pyrites	4	0	34	0
	Sandy bed with large stones (water)	4	0	38	0

16. Bedford Iron Works, Kempston.

Communicated by Mr. J. Costin, well-sinker. Water-level 20 feet from surface.

	Ft.
Oxford Clay	30
Kellaways Beds. Sandy rock	10
Hard Limestone	10
	50

A. C. G. C.

Keysoe.

Geol. map 52 S.E. ; One-inch map N.S. 186 ; Six-inch map 5 S.W.

Harker's Farm. East End. Keysoe Row.

Water stands 1 foot 6 inches in well, and is brackish, but was used formerly for butter-making.

Communicated by Mr. A. C. G. Cameron.

	Thickness. Ft.
Boulder Clay	25
Oxford Clay	50
Kellaways Sand	7
	82

Langford.

Half-mile south of Church, by River Ivel. South of Biggleswade.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six inch map 23 N.W.

Communicated by Colonel Sir R. G. Hennell.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Soil	1	6	1	6
[Glacial Drift]	Boulder Clay	4	6	6	0
	Vein of sand with water	0	6	6	6
	Boulder Clay	8	6	15	0
	Vein of sand with impure water	1	0	16	0
Gault.	Blue clay	9	0	25	0
	Clay	12	0	37	0
[Lower]	Greensand	7	0	44	0

H.B.W.

Water in village obtained from shallow wells "often not exceeding 8 to 10 feet in depth" (Dr. F. St. George Mivart, Report to Local Government Board, 1899).

Leagrave.

Geol. map 46 S.E. ; One-inch map N.S. 220 ; Six-inch map 29 S.E.

Midland Railway Station.

Made and communicated by Mr. R. B. Paten.

Shaft 49 feet, the rest bored.

Chalk	39	308
Gault	269	

The Gault must include some clayey Chalk Marl. The proper reading would probably be Chalk about 100, Gault about 200 feet.

W. W.

Leighton Buzzard.

Geol. map 46 S.W. ; One-inch map N.S. 220 ; Six-inch map 28 S.E.

1. Local Board Waterworks on Stanbridge Road. 319 feet above Ordnance Datum.

Sunk 48 feet ; the rest bored. Made and communicated by Messrs. C. Isler & Co., 1892.

Water level 47 feet 6 in. from surface.

Yield 12,000 gallons per hour.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Gravel, etc.	10	0	10	0
Gault.	Blue clay	32	6	42	6
Lower Greensand.	Dead sand	9	6	52	0
	Blowing red sand and pebbles	3	6	55	6
	Blowing red sand	33	6	89	0
	Blowing grey sand	10	9	99	9
	Grey sandstone	4	9	104	6
	Green stone and grey sand	2	9	107	3
	Grey sandstone	2	9	110	0
	Sandstone and shingle	3	0	113	0
	Grey sandstone	5	0	118	0
	Congealed stone, pebbles and sand	1	6	119	6
	Green sand and pebbles	4	0	123	6
	Stone and green sandy loam	6	6	130	0
	Stone	1	0	131	0
	Green sand and stone	13	0	144	0

2. London & North Western Railway Co., near South entrance to Linslade tunnel. (Bucks.) Six-inch map 28 S.W.

Made and communicated by Messrs. Le Grand and Sutcliff.

About 330 feet above Ordnance Datum. Water-level 35 feet down.

		Thickness.	Depth.
		Ft.	Ft.
	Soil	2	2
[Lower Greensand.]	Soft red sandstone and layers of sand	34	36
	Red sand : a little water	15	51
	Live red sand	31½	82½
	Coarse live sand and small pebbles	10½	93
	Blowing sand	8	101
	Sandy blue clay	3	104
	Blowing sand	5½	109½
	Sand and clay	2½	112

W. W.

3. South of Union, and just south of Dunstable Branch Railway.

Well through Boulder Clay into Lower Greensand, 39 feet deep.

A. C. G. C.

Lower Gravenhurst.

Geol. map 46 N.E. ; One-inch map N.S. 220 ; Six-inch map 26 N.W.

Ion Farm.

Boring by Mr. Wilsher, of Greenfield. Yield 120 gallons a minute.

	Feet.	
[Gault] Clay	150	
[Lower Greensand] Thin brown Rock	2	Water burst up.
	152	

At Ion Lodge and Fielding Farm good supplies were similarly obtained.

Luton.

Geol. map 46 ; One-inch map N.S. 220 ; Six-inch map 33 N.W.

1. Midland Railway. 1881. About 350 feet above Ordnance Datum.

Made and communicated by Messrs. Docwra.

Shaft and cylinders 41½ feet (the bottom 2 feet filled up with concrete).

Water-level about 7 feet down.

	Ft.	
Soft Chalk	? 48	107½
Chalk and beds of flints	59½	

Mr. Cameron had a note from the engineer, who records a well, at the engine-house, 220 feet deep and in Chalk, except for a few feet of gravelly clay at the top.

2. Waterworks. East of Midland Railway Station. About 360 feet above Ordnance Datum.

Communications from Mr. R. T. Lecky and Mr. J. Saunders.

Shaft 50 feet, the rest bored.

	Ft.	
Chalk	224	322
Chalk Marl (called Gault by the workmen)	98	

Mr. R. B. Paten wrote to me, "we just reached the Gault, but did not go into it." W. W.

Mr. Middleman gave the following particulars to Mr. Jukes-Browne, in 1874.

		Ft.	Ft.
Middle Chalk 150 feet.	Saturated chalk	130	130
	Pan of hard chalk [Melbourn Rock, &c.]	20	150
[Lower Chalk] 170 feet.	Saturated chalk	65	215
	Pan of hard chalk [Totternhoe Stone]	9	224
	Gault clay [Chalk Marl]	96	320

Mr. Phillips, C.E., told Mr. Cameron (later) that the water stands 26 feet (down ?), seldom varying beyond a foot, and the yield is 100,000 gallons an hour.

Mr. J. Saunders states that a brick was made, probably from the Gault clay found at a depth of 465 feet at the Old Brewery, in Park Street, Luton.

Mr. A. C. G. Cameron says that over the doorway of the Cock Inn, there is a white brick, in the red brick wall, with the inscription "F. Burr, 465 feet, Jan. 1828."

3. Mr. S. Oliver's, Park St. West. About 350 feet above Ordnance Datum.

Communicated to Mr. Cameron by Mr. Oliver.

	Ft.
[Valley] Gravel	8
Chalk	60
	68

4. Messrs. Brown & Sons, 1898. Made and communicated to Mr. Whitaker by Messrs. Duke and Ockenden.

Shaft varying from 11 to 5 feet in diameter to 35 feet below surface. 12 inch Boring continued to 95 feet below surface in Chalk. Water level 21 feet below surface.

5. Luton Laundry. Six-inch map 32 N.E.

Maidencommon Farm, N.W. of town.

442 feet above Ordnance Datum.

Well 150 feet deep through gravel into Chalk.

6. The Hyde (Col. Ames). One-inch map N.S. 239 ; Six-inch map 33 S.E.

East Hyde Park, over 3 miles S.E. of the town, 1871.

Sunk and communicated by Mr. R. B. Paten.

Shaft 170 feet, the rest bored.

	Ft.
Chalk, with flints [? not flints throughout, but only in upper part]	270

W. W.

Marston Moretaine.

Geol. map 46 N.W. ; One-inch map N.S. 203.

1. BOARD SCHOOL. Six-inch map 21 N.W.

Made and communicated by Mr. J. Fuller.

Shaft 55 feet, the rest bored. Abandoned, no water being found.

		Thickness. Ft.	Depth. Ft.
River gravel		20	20
Oxford Clay		65	85
Great Oolite Series.	Stone, 3, 2 and 2½ feet, another touched at the base, divided by 3 layers of clay each a foot thick	10½	95½

2. WOOD END. Well dug 44 feet ; the rest bored, in 1896.

	Ft.
Oxford clay	78
Kellaways sand	4
	82

3. UPPER SHELTON. Mr. W. Merryweather's Well. Six-inch map 16 S.W.

Communicated by Mr. J. Fuller, Well-sinker, Wootton.

	Ft.
Clay, dug	45
,, bored to sand and water	50
	95

Water stood 2 feet in the well when it was dug to 40 feet. Mr. Fuller, well-sinker, Wootton, deepened it to 45 feet and the water now stands 7 feet in the well. A. C. G. C.

Meppershall.

Geol. map 46 N.E. ; One-inch map N.S. 221. Six-inch map 22 S.E.

Water from shallow wells. (Drift on Lower Chalk and Gault.)

Milton Ernest.

Geol. map N.S. 203. Six-inch map 7 S.E.

CHURCH FARM.

About 200 feet above Ordnance Datum. Communicated by Mr. J. Fuller to Mr. Cameron, 1893.

		Ft.
	Soil	1½
Oxford Clay.	Yellowish clay	10
	Blue clay	15
Kellaways Beds.	Blue sandy rock	7
Great Oolite Series.	Clay and limestone (with water)	19½
		53

Moggerhanger.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 17 N.E.

Wells in or through Boulder clay up to 90 feet deep. About 140 feet above Ordnance Datum.

In a report to the Local Government Board issued in March, 1897, Dr. G. S. Buchanan gave the following particulars :—

"The wells of Moggerhanger, about a dozen in number, are of old construction. They are dry-steined ; and this steining consists of brickwork which is frequently faulty. Water is drawn from them usually by bucket and windlass, sometimes by a pump. Some are 20 feet or more in depth, others are about 15 feet. These wells are fed by surface water which percolates to them through the layers of glacial drift which overlie the Oxford Clay."

Information obtained by Mr. C. E. Hawkins tended to show that "these wells are fed chiefly by surface water percolating through the drift, and only to a small extent, if at all, from any definable water-bearing layer interposed between the Boulder Clay and the Oxford Clay."

"They have apparently been given their depth partly with the object of traversing the whole thickness of these superficial layers, and so of obtaining the greatest amount of water that the drift will yield; partly also they have been sunk more deeply than is common in the case of wells fed merely with surface water, in order to allow for storage in periods of drought. Water is commonly slow in percolating to these wells."

"Some houses in Chalton obtain water from one or two wells which in depth and construction correspond with those at Moggerhanger. Others obtain water from a pond beside the high road from Blunham to Moggerhanger."

In a report to the Local Government Board in 1899, Dr. F. St. George Mivart states that the water supply was for the most part in the same condition as it was when the district was visited by Dr. Buchanan.

Northill.

THE RECTORY, 1877.

Geol. map. 52 S.E.; One-inch map N.S. 204; Six-inch map 17 N.W.

Made and communicated by Messrs Le Grand and Sutcliff.

Water-level 19 feet down.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
[Boulder Clay]	Stony blue clay	43	0	43	0
	Flint and blue clay	3	6	46	6
	Stony blue clay	10	6	57	0
	Flints and blue clay	17	6	74	6
	Blue stony clay	29	6	104	0
[Oxford Clay and Kellaways Beds.]	Green clay	12	0	116	0
	Blue clay	10	0	126	0
	Blue clay and shells	9	0	135	0
	Dark green clay	13	6	148	6
	Black stone	4	6	153	0
	Greenish clay and shells	20	0	173	0
	Live sand	9	0	182	0
	Sandy blue clay	9	0	191	0
	Sand rock	7	4	198	4
	Blue clay and shells	2	6	200	10
	Rock and blue clay	1	9	202	7
[Cornbrash ?]	Limestone	2	8	205	3
[Great Oolite Clay and Limestone.]	Sandy blue clay	3	0	208	3
	Blue stone	3	6	211	9
	Sandy clay	4	10	216	7
	Limestone	4	0	220	7
	Sandy clay and stone	3	0	223	7

The above grouping differs from that given, on authority of Mr. Whitaker, in the Memoir on Jurassic Rocks of Britain, vol. v. 1895, p. 50. In that Memoir the strata from 104 to bottom of boring were grouped as Oxford Clay.

Water elsewhere in village obtained from wells up to about 60 feet deep.

ICKWELL GREEN, UPPER and LOWER CALDECOTE, and HATCH are supplied by shallow wells.

Old Warden.

Geol. map 46 N.E.; One-inch map N.S. 204; Six-inch map 17 S.E.
160 to 190 feet above Ordnance Datum.

Shallow wells in Lower Greensand.

Oakley.

Geol. map N.S. 203.; Six-inch map 11 N.W.

1. For cottages adjoining RAILWAY STATION.

		Ft.
Oxford Clay.	Yellowish sandy loam and mild clay	6
	Blue clay ?	20
Great Oolite Series.	Hard blue stone ?	6
	Hard blue shelly limestone	13

2. Trial holes for Viaduct.

		Ft.
Alluvium.	Yellow clay	3
Estuarine Series.	Blue clay with slabs of iron pyrites	17

A. C. G. C.

Pertenhall.

WOOD END.

Geol. map 52 N.E. ; One-inch map N.S. 186 ; Six-inch map 5 N.W.
About 175 feet above Ordnance Datum.

Shaft to 95 feet, the rest bored. April, 1895.

Communicated by Mr. A. C. G. Cameron.

Yield.—At 95 feet, 2 ft. of water in 12 hrs.
,, 130 ,, 6 ,, ,,
,, 144 ,, 7 ,, ,,
12 ,, from 2 p.m. Sat. till Mon.

		Thickness. Ft.	Depth. Ft.
Soil		2	2
[Boulder clay]	Chalky clay	3	5
Oxford Clay.	Clay	8	13
	Sandy clay	17	30
	Loamy clay	20	50
	Clay	25	75
	Soft moist clay	5	80
	Clay	4	84
	Clay, *Ammonites Jason*	1	85
	Clay, slabby	10	95
	Clay	35	130
[Kellaways Beds.]	Grey sand and Belemnites	13	143
	Clay	1	144

Podington.

(Puddington on old series map.)

HINWICK HALL.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 3 S.W.

Communicated to Mr. Beeby Thompson by Mr. W. Smart.

Water rises 7 feet ; quantity 3,000 gallons per hour.

		Ft.
	Soil	2
Estuarine Beds ?	Sandy loam	2½
	Sand	7½
		12

A good deal of lignite has been met with in the parish, probably in the Estuarine Beds. Mr. Cameron refers to records of "coal pits" in 1826. (*See* "Hist. and Antiq. of the Hundred of Willey," by W. M. Harvey.)

Potsgrove.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 24 S.E.

1. SAND HOUSE. W. of village.

Made by Fenny Stratford Urban District Council, 1907.

Communicated by Mr. John Chadwick, F.G.S., to Mr. B. Thompson.

Height above Ordnance Datum 393 feet. Rest-level of water 298 feet above Ordnance Datum ; 95 feet from surface.

12-inch borehole down to 50 feet.
6-inch ,, remaining 150 feet.

		Thickness. Ft.	in.	Depth. Ft.	in.
Drift.	Loam	2	0		
	Gravel	4	0		

1. SAND HOUSE—continued.

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Lower Greensand.	Yellow sand	16	0		
	Light yellow clay	4	0	26	0 ?
	Dark clay with sand	34	0	60	0
	Stone		3		
	Greensand	4	9		
	Stone		3		
	Greensand	5	0		
	Stone		3		
	Greensand	10	0		
	Stone		3		
	Greensand	3	9		
	Stone		3		
	Greensand	10	0	94	9
	Green sandstone	19	3	114	0
	Running sand with water	71	0	185	0
Oxford Clay.	Oxford clay	15	0	200	0

2. SHEEP LANE.

From notes by Mr. H. Bauerman.

		Ft.
Drift and ? Gault.	Clay	50
Lower Greensand.	Loose sand	30
	Rocky	10
	Sand with stonebands (water)	86
		176

The following wells were made and communicated by Mr. J. Dolton.

3. SHEEP LANE SHOOL. Water at the bottom.

[Boulder Clay.]	Clay	90	186 feet.
[Lower Greensand.]	Loose sand	96	

4. CLOSE TO CHURCH. Clay 30 feet.

5. FARM N. OF CHURCH. Clay on gravel, 10 feet.

Potton.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch maps 13 S.E. and 18 N.E.
125 to 150 feet above Ordnance Datum.

Wells up to about 40 feet in depth in Lower Greensand.

Pulloxhill.

HIGHAM BURY.

Geol. map 46 N.E. ; One-inch map N.S. 220 ; Six-inch map 25 N.E.
300 to 350 feet above Ordnance Datum.
1 mile S.W. of Church.

Communicated by Mr. Edward Jekyell to Mr. Cameron.
Dug 80 feet ; bored 60 feet.

		Ft.
[Boulder Clay.]	Clay	25
[Gault.]	Clay	115
		140

At the bottom, 1 foot of rock. Water stands 110 feet in the well, and the supply has never given out. A small but insufficient supply was got at 20 to 30 feet. The water in this well is objectionable to the taste, especially if it has stood long in the iron pipe of the pump.

Ravensden.

Geol. map one-inch N.S. 203. Six-inch map 12 N.W.

In this parish water has been obtained from a spring at the "Long Close" pond for the supply of Ravensden Grange, and from deep wells which, however, do not yield an abundant supply.

Renhold.

Geol. map one-inch N.S. 203 ; Six-inch map 12 N.W.
150 to 187 feet above Ordnance Datum.

A few wells 10 to 12 feet deep in boulder clay ; also ponds on boulder clay have been utilised.

Good supplies have been obtained at Howbury Hall from two deep wells ; at the Renhold brickfield from a well sunk 35 feet deep, in 1879 ; at Hill Farm ; and at Great Dairy Farm.

For these and the following particulars we are indebted to a report on village water-supplies, printed in the "*Bedfordshire Standard*," August 11th, 1888.

"Workhouse End" during drought is chiefly supplied by a large pond and dip well—never dry—at Mr. Thos. Joyce's "Woodfield Farm," and in the wet season the overflow from this source feeds several water holes arranged near the cottages. At "Brook End Farm," occupied by Mr. John Long, is a deep well, with constant supply of good water. At the "Horse Shoes" public house is a well twenty feet deep, fitted with pump inside, giving a constant supply, and at the two cottages on the opposite side of the road a well has been sunk within the last two months, depth twenty-three feet, giving an abundant supply of good drinking water. At Miss Raines' cottages, "Top End," is a well, twenty feet deep, affording a fairly good spuply ; and almost opposite these cottages at Mr. Geo. Buck's, sen. is a well forty feet deep, from which all the surrounding cottages have been supplied when Miss Raines' well had run dry. At "Little Church Farm" is also a deep well with good supply. At the vicarage are two good wells, one recently sunk in the orchard, both yielding a copious supply of good water. At Mr. George Harrison's Farm, near "The Polhill Arms" public house, there is a deep well with good supply ; and at Mr. Geo. Buck's, jun., adjoining, a well was deepened about a month ago, with very satisfactory results. At Mr. Ivett's brickyard are two wells with good yield ; and near there is also a good well, twenty feet deep, in a garden by the roadside, which was sunk about thirteen years ago upon the recommendation of this Authority, which has never been dry ; the water in this well rises to within three feet of the surface. At the "Charity Cottages" is a good well, forty feet deep, which was sunk by the late Vicar. Salph End is amply supplied with good water."

Roxton.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 12 N.E.
75 to 100 feet above Ordnance Datum.

There were 22 wells in the village in 1886, from 12 to 20 feet deep.

At the Royal Oak :

	Ft.
Chalky and gravelly clay - - - -	20
Gravel with water - - - - - -	–

A. C. G. C.

Ridgmont.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 21 S.W.
390 to 397 feet above Ordnance Datum.

1. Parish well (good water, usually abundant) 100 feet in Lower Greensand.
2. Near Methodist Chapel, 70 feet Lower Greensand.

A. C. G. C.

Sandy.

Geol. map 52 S.E. ; One-inch map N.S. 204 ; Six-inch map 13 S.W., 18 N.W.
90 to 115 feet above Ordnance Datum.

Water obtained in Lower Greensand, from wells "generally dry-steined, and of an average depth of 25 to 30 feet." Dr. F. St. George Mivart, Report to Local Government Board, 1899.

Sharnbrook.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 7 N.W.

1. Cottages belonging to L. S. Gibbon, Esq. of Sharnbrook Grange.

Communicated by Mr. Cameron.

	Ft.
Gravel and rubble [Great Oolite Limestone]	20
Clay. Somewhat greenish, mostly blue or blackish-blue (bored)	50

The clay may represent Upper Estuarine Series and Upper Lias.

2. Near Stoke Mill. 146 feet above Ordnance Datum.

Communicated by Mr. Whitaker.

Shaft 21 feet : the rest bored.

		Ft.
[Valley Drift.]	Soil	4
	Loamy Sand	7½
	Flint Gravel	5
[Upper Estuarine Series.]	Grey clay	1
	Blue clay	11½
		29

3. Near to Stoke Mill. Communicated by Mr. Whitaker.

Shaft 34 feet : the rest bored.

Drawing in Office [and specimens].

Water-level 14 feet 9 inches down.

		Thickness. Ft.	Depth. Ft.
[Valley Drift.]	Soil	6	6
	Loamy sand	11	17
[Upper Estuarine Series to Upper Lias.]	Blue clay [dark grey, bedded, at 17 ; dark grey at 23]	9	26
	Grey clay [very pale, hard, sandy, not unlike hard chalk marl, almost stone]	4	30
	Running sand [fine, sharp, nearly white] many bits of pyrites in this	4	34
	Blue clay [36½, dark grey sandy ; 40 ditto ; very dry, fine ; 42 grey clay ; 47 grey clay ; 49½ grey clay ; 52 grey clay ; 65 grey clay ; 76 grey clay ; 80 grey clay ; 95 grey clay ; 100 grey clay ; broken shell]	66	100

4. Colworth House.

Well 30 feet clay to fossiliferous rock—water abundant.

[? Boulder clay to Cornbrash.]

Shefford.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six-inch map 22 S.E.
About 140 feet above Ordnance Datum.

Water in village mostly obtained from shallow wells in Lower Greensand or through Gault into that formation.

Shillington.

Geol. map 46 N.E. ; One-inch map N.S. 221 ; Six-inch map 26 N.E.
170 to 200 feet above Ordnance Datum.

1. Coprolite-work just south of Hanscombe End, on west side of village.

Information from Mr. Mason, given on the spot (1868), to Mr. W. Whitaker.

Shaft 40 feet, the rest bored.

Water rises to within 8 feet of the surface.

Through a very little Chalk Marl, the Coprolite bed and the Gault, with a bed of coprolites at 180 feet [? at bottom], about 190 feet ; and Sand [Lower Greensand] about 30 feet.

2. VICARAGE.

[Through a little Chalk Marl, the Coprolite bed, and the Gault] about 200 feet.

3. SHILLINGTON BURY or BURY END.

Dug through about 20 feet of Boulder Clay, and then Gault, which was bored (1868) to a depth of 190 feet.

Silsoe.

Geol. map 46 N.E. ; One-inch map N.S. 220 ; Six-inch map 26 N.W.

WREST PARK, WHITE HALL LODGE, south of mansion. About 180 feet above Ordnance Datum.

Boring through blue clay [Gault] to sand [Lower Greensand].

Prof. E. J. Chapman remarked in 1852 :—" This well is 186 feet deep, with a bore of four inches in diameter. The water gushes out with great force, day and night, in a continued stream, and at the rate of about 76 gallons a minute."

Hardness	9°·38
Alkalinity	8°·50

(*Phil. Mag.* Ser. 4, Vol. iv., p. 104.)

Souldrop.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 7 N.W.

About 317 feet above Ordnance Datum.

WELL near CHURCH FARM.

60 feet through Boulder Clay into Kellaway's Beds ? Water somewhat ferruginous.—A. C. G. C.

Southill.

Geol. map 46 N.E. ; One-inch map N.S. 204 ; Six-inch map 22 N.E.

1. 650 yards west of STANFORDBURY FARM.

Communicated by Messrs. Easton and Anderson.

About 235 feet above Ordnance Datum.

Yield 7 gallons a minute.

Sunk 47 feet ; bored 111 feet.

	Thickness. Ft.
Boulder clay	35
Gault	56
Sand [Lower Greensand]	67
	158

2. MR. WHITBREAD'S WELL.

Communicated by Mr. Cameron.

Depth 140 feet. Water-level 30 feet from bottom.

3. COTTAGES OVER TUNNEL.

Communicated by Mr. Hannam.

	Ft.
Dug	40
Bored	70
	110

Plentiful yield from Lower Greensand.

Many houses supplied by shallow wells at SOUTHILL and at the hamlet of BROOM.

Stagsden.

Geol. map 203. ; Six-inch map 11 S.W.

WELL HOUSE. 177 feet above Ordnance Datum.

Sunk by Mr. J. Costin and communicated to Mr. Cameron by Mr. S. Foster

Water-level 70 feet from surface.

Boulder clay.	Clay with chalk	80 feet.
Jurassic.	Clay	
	Rock	

Steppingley.

Geol. map 46 N.W.; One-inch map N.S. 220; Six-inch map 25 N.W.
About 350 feet above Ordnance Datum.

Wells here are usually through from 60 to 70 feet of Lower Greensand, to the Ampthill Clay and water.

A. C. G. C.

Stevington.

Geol. map N. S. 203; Six-inch map 11 N.W.
About 150 feet above Ordnance Datum.

WELL at MR. ROUGHEAD'S (Blacksmith).

Communicated by Mr. Cameron.

Supplies 7 cottages. Water stands 15 feet deep.

		Ft.
Great Oolite Series.	Clay	10
	Rock	4
	Clay	10
	Rock	28
		52

Stotfold.

(See also p. 31.)

Geol. map 46 N.E.; One-inch map N.S. 221; Six-inch maps 23 S.E., 27 N.E.
150 to 160 feet above Ordnance Datum.

MR. SAUNDERS' HOUSE, near the church.

Information from Mr. J. Conder, well-sinker.

Sunk through 25 feet of soft clunch, with coprolites at the base, and then a little way into blue clay [Gault].

A. J. J. B.

Sundon.

Geol. map 46 N.E.; One-inch map N.S. 220; Six-inch maps 29 N.E., S.E.
About 443 feet above Ordnance Datum.

N.W. of LUTON. 1903.

Communicated by Mr. W. Whitaker.

			Ft.
	Chalk and Gault	to about	320
Lower Greensand.	Sand	,,	341½
	Clayey beds, sandy clay, sandier lower, and about bottom a fine compacted (? clayey) sand	,,	369

Tempsford.

Geol. map 52 S.E.; One-inch map N.S. 204; Six-inch maps 12 N.E., 13 N.W.
60 to 90 feet above Ordnance Datum.

Dr. F. St. George Mivart reported to the Local Government Board in 1899 that "There is no public water supply. The private wells, two or three of which are said to yield a short supply in dry summers, are shallow and generally dry steined. . . . . They are generally of the 'dip' kind; others are fitted with windlass and chain. The edges of most of the wells were found to be flush with the surface of the ground, a wooden collar being generally furnished, to which a more or less ill-fitting or broken cover is fixed."

Wells dug in Gravel on Oxford Clay.

Thurleigh.

Geol. map 52 S.E.; One-inch map N.S. 186; Six-inch map 7 S.E.

Ponds in area of Boulder-clay have been utilised as a source of water-supply.

Tingrith.

Geol. map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 25 S.W.

At Herne Dairy Farm [now Hernegreen Farm] near Tingrith, a well had been sunk 40 to 50 feet through Boulder-clay. (From a note by Mr. H. Bauerman.)

Wilden.

Geol. map N.S. 203 ; Six-inch maps 8 S.W., S.E.

Supplied in part from "water holes" on Boulder Clay or Oxford Clay.

"At the vicarage there is a deep well still yielding a good supply, and adjoining upon the school property is a well seventeen feet deep, which was sunk about eighteen years ago, also yielding a plentiful supply of good water, and which has never been dry. At the 'Manor Farm' there is a good supply throughout. On the road leading to Renhold are several small holdings, including 'Fensome's Farm,' and some old cottages, owned by Mr. Ivett, brickmaker, supplied by wells on the premises."—From the *Bedfordshire Standard*, August 11th, 1888.

Willshamstead.

Geol. map N.S. 203 ; Six-inch map 17 S.W.

COTTON END.

Dug 50 feet. Good supply.

	Ft.
[Oxford] Clay	95
[Kellaways] Sand	5
	100

Woburn.

1. WOBURN PARK, close to western corner of Milton Wood.

Geol. Map 46 N.W. ; One-inch map N.S. 220 ; Six-inch map 24 S.E.

446 feet above Ordnance Datum.

Made and communicated by Messrs Le Grand and Sutcliff, 1898, to Mr. W. Whitaker.

Water-level in March, 1898, 159 feet from surface.

		Thickness. Ft.	in.	Depth. Ft.	in.
Alluvial Drift.	Yellow clay	1	0	1	0
	Boulder clay (blue)	73	0	74	0
	Fine sand (a little soakage of water)	0	6	74	6
	Loam, stones and shells [brownish-grey clayey sand and quartz pebble]	7	6	82	0
	Sand	5	0	87	0
	Sandy clay	3	0	90	0
	Boulder clay [dark grey clay with bits of chalk, flints and other stones]	16	0	106	0
[Lower Greensand.]	Hard sandy clay	6	0	112	0
	Sandy rock and clay	37	0	149	0
	Sand (dark grey) and clay mixed : water touched at 161 feet	25	0	174	0
	Fine sand and thin layers of clay	14	0	188	0
	Sand	3	6	191	6
	Green sand, clay and stones	8	6	200	0
	Green sand and clay (at 202 feet somewhat dark greenish sand with hard lumps,	21	0	221	0
	Green sand	10	6	231	6
	Green sand and clay	20	6	252	0
	,, ,, ,, ,,	17	0	269	0

2. WOBURN ABBEY. Information from Mr. T. Preston.

An old well 86 feet deep has been found within the Abbey. It is now filled up. For many years it was used as a cess-pit.

Six-inch map 24 N.E.

3. PARK KEEPER'S HOUSE.

Boulder Clay, Lower Greensand, and Oxford Clay. Thickness not known. Good water at 90 feet.

4. PARK FARM OFFICE. From Mr. Preston.

Boulder Clay.	Clay with stones and fragments of ironstone at top.	about 68	73
Lower Greensand.	Ironstone and dark red sand, chiefly.		
	Nearly white sand.	,, 5	

Supply good but not plentiful, when only 69 feet deep. After deepening it was bad and smelt strongly, like chloride of lime.

A. C. G. C.

5. GAS WORKS, west of town, on road to little Brickhill.

[Boulder] Clay, 40 feet, when water broke in (said to be from side), and rose to the surface.

W. W.

6. POLICE STATION WELL.

Communicated by Mr. John Chadwick, F.G.S., and Mr. Beeby Thompson F.C.S., F.G.S.

Top.	409	feet above Ordnance Datum.
Water-level at 91½ feet.	371½	,, ,,
Bottom at 96 feet.	313	,, ,,

Water from Lower Greensand. Clay not reached.

7. PINFOLDPOND WELL, near Woburn Police Station.

Communicated by Mr. John Chadwick, F.G.S. and Mr. Beeby Thompson, F.C.S., F.G.S.

Top.		368	feet above Ordnance Datum.
To pump stage	43 feet	325	,, ,,
To water probably	50 ,,	318	,, ,
To bottom probably	55 ,,	313	,, ,,

Lower Greensand Water.

8. IN LOWE'S WOOD.

Well just on border of county between Woburn and Little Brickhill.

Communicated by Mr. Benjamin Giles, well-sinker, Woburn Sands, to Mr. Chadwick and Mr. Thompson.

Top	about	492	feet above Ordnance Datum.
To water about 114 feet	,,	378	,, ,,
Bottom ,, 116 ,,	,,	376	,, ,,

Water from Lower Greensand. Clay not reached.

? WOBURN. (? Aspley Heath).

In the bottom of the valley about a sixth of a mile N.E. of Longslade Cottage. 1902.

Trial boring. Communicated by Mr. D. Balfour to Mr. Whitaker.

		Thickness. Ft.	Depth. Ft.
Soil		2	2
Gravel		6	8
Lower Greensand.	Sand	22	30
	Fullers' Earth	¾	30¾
	Sand	12	42¾
	Stone	½	43¼
	Water-bearing sand	11¾	55
	Fullers' Earth	4	59
	Water-bearing sand	26	85
Oxford Clay		20	105

9. HORSEMOOR FARM (Duke of Bedford's).

Made and communicated by Messrs. Le Grand & Sutcliff.

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
[Lower Greensand.]	Sand and clay	5	0	5	0
	Loam	1	0	6	0
	Sand and ironstone	5	0	11	0
	Loam and stone	3	0	14	0
	Loam	9	0	23	0
	Loam and stone	5	0	28	0
	Sand	1	0	29	0
	Loam	62	0	91	0
	Sandy loam	1	0	92	0
	Loam and small black pebbles	15	0	107	0
	Yellow loam	3	0	110	0
	Green loam	30	0	140	0
	Yellow loam	7	0	147	0
	Green and yellow loam	3	6	150	6
	Hard green sandstone	3	0	153	6
	Green sandy loam	6	6	160	0
	Hard rock	1	9	161	9
	Sandy loam	20	3	182	0
	Clay loam and pebbles	4	0	186	0
Oxford Clay.]	Blue clay	2	0	188	0

10. BIRCHMOOR ARMS, N. of Woburn.

Communicated by Mr. Giles to Mr. Chadwick and Mr. Thompson.

Top—348 feet above Ordnance Datum.

? Gault. Clay a little.
Total depth - - - - - - 40 feet.
About 2 feet of water.
Therefore water-level about 310 feet above Ordnance Datum.
Lower Greensand water.

11. BIRCHMOOR FARM.

Well sunk 43 feet; the rest bored.

Communicated to Mr. Whitaker by Messrs. D. Balfour and Sons, Engineers, Newcastle-on-Tyne, 1904; with additional notes by Mr. B. Thompson, 1908.

325 feet above Ordnance Datum. Water level 20 feet from top.

Yield about 240,000 gallons a day.

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Soil, &c.	Black soil	2	0	2	0
	Loamy clay	2	6	4	6
[Lower Greensand.]	Red sand	2	6	7	0
	Light grey sand	35	0	42	0
	Green sand	1	0	43	0
	Green sand rock	7	0	50	0
	Green sand	9	0	59	0
	Red, green and grey sand; mixed veins	27	0	86	0
	Red and grey sand	22	0	108	0
	Dark brown sand	92	0	200	0

A ferruginous spring has been recorded as occurring at Priestly Bog, Woburn.

Wootton.

Geol. map N.S. 203; Six-inch maps 16 N.W. and S.W.

About 150 feet above Ordnance Datum.

1. KEELEY LANE. Mr. Joyce's Farm.

Communicated by Mr. Joseph Fuller.

Dug 32 feet; the rest bored

Water abundant; stands 15 feet in well.

		Ft.
[Drift?]	Brickearth	15
[Oxford Clay]	Black clay	39
[Kellaways Beds]	Yellow sand	6
		60

Deepened 7 feet in 1892, after which water stood 15 feet in well.

2. In another well at Keeley Lane, made for Mr. Henry Low, water was obtained at a similar depth through 50 feet of clay, into 10 feet of bright yellow sand.

3. Williamson's Well. 1892.

Sunk 24 feet; the rest bored.

	Ft.
Gravel and sand (a little water)	4
Oxford Clay with pyrites and water	40

4. Hall End. Parish well. 1891. Dug 50 feet.

		Ft.
	Brickearth	10
[Oxford]	Clay	45
[Kellaways]	Sand	5
		60

At another well on "Charity Ground," Hall End, the sand was reached at depth of 79 feet.

5. Wootton House.

Dug 60 feet.

		Ft.
[Oxford]	Clay	105
[Kellaways]	Sand	5
		110

6. Vicarage.

Dug 30 feet.

		Ft.
[Oxford]	Clay	55
[Kellaways]	Sand	5
		60

7. Bott End. Water obtained through clay at depth of 59 feet.

The above records were communicated by Mr. J. Fuller, well-sinker, to Mr. Cameron. Good supplies of water were obtained.

Wrestlingworth.

Geol. map 52 S.E.; One inch N. S. 204; Six inch map 18 N.E.

Water from shallow wells in Glacial drift over Gault. Deficient in summer. Dr. F. St. George Mivart, Report to Local Government Board, 1899.

Wymington.

1. Rushden Waterworks.

Geol. map 52 N.W.; One-inch map N.S. 186; Six-inch map 3 S.E.

Communicated in part to Mr. Whitaker by Mr. W. Pare, Surveyor to the Urban District Council, and in part from notes by Mr. Madin and Mr. B. Thompson.

Four wells, on the north side of the brook, and one on the south, varying from about 26 to 40 feet in depth.

Water-level nearly 204 feet above Ordnance Datum.

Supply exhausted after about 3 hours pumping; but the water rises to the normal level again after about 2 hours.

The wells are in gravel with a clay sump from 8 to 12 feet deep, but the water is probably derived from the Northampton Sand.

Supply since obtained from Sywell in Northamptonshire.

2. Rushden Waterworks, at back of Pumping Station, Wymington. Six-inch map 40 S.W.

On North side of stream about 30 chains west of Wymington Rectory. About 220 feet above Ordnance Datum.

Trial boring by Messrs Timmins, Runcorn.

Communicated by Mr. W. Whitaker from record at the Office and specimens, and information from Mr. A. C. G. Cameron. 1898.

No water.

		Thickness. Ft.	Depth. Ft.
Drift.	Gravel and sand	22	22
Upper Lias ?	Light grey clay, rather sandy	68	90
	Bits of stone	1	91
	Light grey clay	69	160
	Bits of stone. Ammonites found	10	170
	Light grey clay	3	173
Middle Lias ?	Bits of stone, with septa of Ammonite in pyrites, also *Bourguetia*, *Pinna*, *Pleuromya*	8	181
	Light grey clay	66	247
	Bits of stone, full of shells	1	248
	Light grey clay	1	249
	Bits of stone	11	260
	Bits of stone, and coarse sandy earth ?	4	264
	Much broken up stone	6	270
Lower Lias ?	Light grey clay or marl	3	273
	Broken up stone, mostly very small, and clay: small specimen of very shelly stone yielded *Leda graphica*	4	277
	Broken up stone and coarse sandy earth (? much broken up stone). One piece of cone in cone one piece with shells; and clay	4	281
	Light grey clay, some shells	8	289
	Broken up stone, small belemnite, broken up shells and sandy earth	11	300

It is difficult to correlate the strata, and the grouping is given doubtfully. Many of the specimens of stone indicated septaria, and all the details above recorded are given from specimens seen by Mr. Whitaker—the fossils were named by Mr. E. T. Newton. Mr. Beeby Thompson remarks that the gravel in this section cuts through the natural level of the Northampton Sand; hence the Upper Lias must be nearly complete H. B. W.

WELLS AND BORINGS IN NORTHAMPTONSHIRE.

Abington.

Geol. map 52 S.W. One-inch map N.S. 185 ; six-inch map 45 N.W.

Communicated by Mr. BeebyThompson from information supplied by Mr. "Jack" Pearson, who worked at the well for Mr. Henry Green.

Well on "CAMPIONS HILL", Kettering Road, W. of Abington Lodge, and near to the second milestone from Northampton. (Mr. Jas. Colliers property).

		Ft.	in.	Ft.	in.
Boulder Clay ?	Blue clay	3	0	3	0
Great Oolite.	Limestone, with water	9	0	12	0
Upper and Lower Estuarines	Clay	45	0	57	0
Northampton sand.	Ironstone—blue hearted	9	0	66	0
	Deepened since in ironstone 4 or 5 feet	5	0	71	0

The limestone yields a great deal of water soon after rain, which shoots right across the well, but soon runs dry.

The ironstone was not pierced, it yielded too much water.

The 45 feet of clay of course includes the various sandy beds of the Lower Estuarine series (*see* account of wells at Moulton Park and Weston Favell House).

Apethorpe.

Geol. map 64 ; one-inch map N.S. 171 ; six-inch map 12 N.E.

Communicated to Mr. Beeby Thompson by Mr. W. Smart.

1. LODGE FARM.

		Ft.	in.	Ft.	in.
Great Oolite Limestone.	Soil	2	6	7	6
	Rock	5	0		
? Upper Estuarine 41 feet 6 inches	Clay	22	6	49	0
	Blue stone with shells	3	0		
	Hard dark clay	9	0		
	Hard sand	7	0		
? Lincolnshire Oolite 15 feet.	Hard blue rock	15	0	64	0
? Lower Estuarine	White sand	9	0	73	0

Water rises 8 feet ; 2,000 gallons per hour.

2. SHIREHILL.

	Ft.
Soil	1
Clay	15
Hard rock	15
Clay	30
Blue rock	17½
	78½

Water rises 3 feet ; quantity 1,000 gallons per hour.

Appletree.

Geol. map 53 S.W. ; One-inch map 201 Six-inch map 54 N.W.

Communicated by Mr. Beeby Thompson.

The Marlstone rock-bed around Appletree is superficial, and the only reliable source of water is from a bed in the Middle Lias some 30 feet below the rock-bed, as will be seen from the following records of depths :—

1. Appletree House Well. Top 467 feet above Ordnance Datum.

	Ft.	in.
To water.	37	0
Water.	2	10
	39	10

2. Rickyard Well. Top 469 feet above Ordnance Datum.

	Ft.	in.
To water.	40	6
Water.	1	2
	41	8

3. Well in Field to the East. Top 476 feet above Ordnance Datum.

	Ft.	in.
To water (no useful supply).	31	7

4. Well in adjacent Field to the North, near Barn. Top 477 feet above Ordnance Datum.

	Ft.	in.
To water.	34	3
Water.	6	10
	41	1

The water comes from a purplish grey stone with *Gryphæa cymbium*, etc.

5. Well to Cottages at Appletree. Top 477 feet above Ordnance Datum.

	Ft.	in.
To water.	34	2
Water.	4	4
	38	6

Not much water.

Arthingworth.

One-inch map N.S. 170 ; Geol. map 52 N.W. ; Six-inch map 24 N.W.

Communicated by Mr. Beeby Thompson, from information supplied by Mr. G. Whale, of Crewe.

1. In field about 220 yards S.E. of KELMARSH STATION.

Boring.

Top about 370 feet above Ordnance Datum.

Upper Lias.	Clay with two beds of rock 8 inches thick, between 70 and 78 feet - - - - -	78 feet.

A small quantity of water was tapped at 68 feet.

This 4½ inch boring was put down by the L. & N. W. Railway Co., in 1900, and it appears pretty clear from the description that the two Cephalopoda beds near the base of the Upper Lias were passed through, and that the upper one—the one at the top of the "Communis" beds—yielded some water, as is usual. Probably the Marlstone proper was not reached, but then it is an uncertain rock in this district.

2. RAILWAY ARMS INN, near Kelmarsh Station.

Well. Top about 375 feet above Ordnance Datum.

	Ft.
Dug about	40
Bored about	20
	60

All blue clay of the Upper Lias.

Water stood (June, 1901) 21 feet from the surface, but was probably only surface water, as no definite water-bearing rock was encountered.

Ashby St. Ledgers.

One-inch map N.S. 185 ; Geol. map 53 N.E. ; Six-inch map 36 N.W.

1. Communicated by Mr. Beeby Thompson from information supplied by Mr. J. B. Williams.

The wells in Ashby St. Ledgers appear to be all supplied from Drift beds, gravel or sand. A well in the westerly part of the village, south side of main street had the following section:—

	Ft.
Boulder clay	24
Gravel with chalk stones	4
	28

2. MANOR HOUSE.

From information supplied to Mr. Thompson by Mr. Cooper, Hillmorton.

The water supply for the Manor House comes from a sand-bed two-thirds of a mile to the north of Ashby, towards Kilsby tunnel ; the section is apparently:—

	Ft.
Boulder clay	2
Black sand and gravel	2
Clear whitish sand	6
	10

The well is situated near to a spring in the valley, and there is abundance of water.

Ashton.

One-inch map N.S. 171 ; Geol. map 64 ; Six-inch map 19 N.W.

ASHTON WOLD.

Made and communicated by Messrs. Le Grand & Sutcliff, London.

Water varies according to working, being anywhere between 90 and 140 feet.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Glacial Drift.	Clay and stones	76	0	76	0
Oxford Clay and Kellaways Beds.	Hard clay	37	0	113	0
	Rock	0	3	113	3
	Sandy clay	19	9	133	0
Cornbrash.	Rock	6	0	139	0
Great Oolite Clay 9 ft. 6 in.	Clay and stone	2	0	141	0
	Clay	4	0	145	0
	Stone	1	6	146	6
	Clay	2	0	148	6
Great Oolite Limestone.	Stone [Rock]	17	6	166	0
Estuarine Beds.	Clay	6	0	172	0
	Clay and shells	10	0	182	0
	Clay and stone	8	0	190	0
Upper Lias.	Clay	11	6	201	6
	Dark loamy clay and thin veins of sand	8	6	210	0
	Dark blue clay and small pieces of stone (nodules)	4	6	214	6
	Dark clay	24	6	239	0

Badby.

One-inch map N.S. 185 ; Geol. map 53 S.E. ; Six-inch map 43 S.W.

Communicated by Mr. Beeby Thompson.

All the wells in Badby apparently derive their water from beds of the Middle Lias below the rock-bed. No actual section of one is available, but the differences in water-level in these and of the springs around indicate four distinct water-bearing beds in the Middle Lias. Some of the wells are given below :—

1. Well at back of houses close to Honey Lane. Top 457 feet above Ordnance Datum.

	Ft.
To water	32

2. "Churchill House" Well. Top 470 feet above Ordnance Datum.

	Ft.
To water (reported)	55

3. Well near to junction of roads, southern end. Top 428 feet above Ordnance Datum.

	Ft.	in.
To water	14	7

4. Well in garden near to Sand Pit. Top 441 feet above Ordnance Datum.

	Ft.
To water	25

A spring in Honey Lane at 429 feet above Ordnance Datum is now used as a public supply for the village.

Barby.

One-inch map N.S. 185 ; Geol. map 53 N.E. ; Six-inch map 28 S.E.

Communicated by Mr. Beeby Thompson.

From information imparted by Mr. Herbert Norman and from personal observation.

1. Well and boring at the "ARNOLD ARMS" INN at junction of roads leading to Daventry, Kilsby and Rugby. Top about 469 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
	From Excavation near the well.				
Drift	Yellow clay, pebbles and flint	6	0	6	0
	Ironstone rock yielding some water	1	0	7	0
Lower Lias	Blue clay	5	0	12	0
	Very hard blue rock—fossiliferous and highly pyritous	1	6	13	6
	Well.				
	Blue clay, with *Ammonites Valdani* (Ibex zone ?)	46	6	60	0
	Boring.				
	Blue clay	60	0	120	0

Some water came in from about 11 feet down in the well itself, but there was very little, and that little was highly charged with saline matter. Another source of supply was adopted.

2. Well at WHITE HOUSE, not far from Arnold Arms.

	Ft.	in.
To water	35	6
Water	5	0
	40	6

Said to be a good supply.

Blakesley.

One-inch map N.S. 202 ; Geol. map 53 S.E. ; Six-inch map 54 N.E.

Communicated by Mr. Beeby Thompson from information supplied by Mr. J. B. Williams, and Mr. J. S. Constable.

Upwards of a dozen borings were put down within half a mile of Blakesley, to the west, a few years back in trying for water. Some of the results are recorded below, the shallower ones on the slopes, with discordant water-levels, being omitted :—

1. Top 470 feet above Ordnance Datum.

		Ft.
Northampton Sand	Sand and stone	17
	Ironstone	1
	Sand and stone	1
		19

Water found at 14 feet 6 inches, stands at 9 feet (461 feet above Ordnance Datum).

2. Top 475 feet above Ordnance Datum.

		Ft.
Northampton Sand	Sand and stone	25
	Clay	?

Water found at 17 feet, stands at 12 feet (463 feet above Ordnance Datum).

3. Top 475 feet above Ordnance Datum.

	Ft.
Sand and stone	17½
Clay and stone	4½
	22

Water found at 17 feet 6 inches, stands at 14 feet (461 feet above Ordnance Datum).

4. Top 482 feet above Ordnance Datum.

		Ft.
Northampton Sand	Red clay	9½
	White sand	5
	Red sand and stone	11½
	Clay	?
		26

Water found at 21 feet, stands at 18 ft. 6 ins. (463 ft. 6 in.)

5. Well. (Six-inch map 50 S.E.)
Upwards of a mile N.W. of Blakesley.
Communicated by Mr. J. B. Williams.
Top 471 feet above Ordnance Datum.

		Ft.
Northampton Sand	Sandy Marl	9½
	Sand and sandstone rock	15½
Upper Lias	Blue clay	25
		50

Water found at 15 feet, stands at 10 feet (461 feet above Ordnance Datum). Yield 72,000 gallons per day.

6. Well for Public Water Supply, half-a-mile N.W. of Blakesley ; made 1902.
Six-inch map 55 N.E.
Communicated to Mr. Beeby Thompson by Mr. J. S. Constable.
Top approximately 485 feet above Ordnance Datum.

		Ft.		Ft.
	Clay (Boulder clay ?)	7	to	8
	Ironstone (?)			6
Northampton Beds	Running sand	8	to	9
	Ironstone rock	7	to	8
Upper Lias	Clay	15	to	20
	Actual depth			50

Water may stand 25 feet or more in the well after rain; probable yield 10.000 to 15,000 gallons per day.

The site for this well was selected by a "diviner," but as will be perceived, water is found all over this area at almost identically the same level. The whole water-scheme was a gift to the village by Mr. C. W. Bartholomew, of Blakesley Hall.

Blisworth.

Geol. map 53 S.E.; One-inch map N.S. 202; Six-inch map 51 N.E.

Communicated by Mr. Beeby Thompson from information supplied by Mr. F. W. Millner.

Boring at BLISWORTH WHARF.

Top 298 feet above Ordnance Datum.

		Ft.
Upper Lias.	All clay	66

No water.

Bozeat.

Geol. map 52 S.W.; One-inch map N.S. 186; Six-inch map 46 S.E.

Communicated by Mr. Beeby Thompson from information supplied by Mr. W. Smart.

EASTON LODGE near to Bozeat Grange.

Well.

Top near to 360 feet above Ordnance Datum.

Water at 120 feet from limestone (Great Oolite, ?), beneath much Boulder Clay.

Brackley.

Geol. map 45 N.E.; One-inch map N.S. 219; Six-inch map 63 N.W.

Communicated by Mr. Beeby Thompson.

So far as the writer can make out the following is the history of the Brackley Wells:—

A well to the Marlstone was first suggested by Dr. Haviland, Medical Officer to a number of sanitary authorities, and Mr. Samuel Sharp, when appealed to, recommended such a well. In consequence, a well and boring were made on high ground immediately to the west of the town.

No accurate record was taken by anyone of the well itself, which went to the bottom of the Northampton Sand, and this is no doubt why the two following accounts differ in important particulars.

1. FIRST WELL.

Description by Mr. Thos. Judge, of Brackley.

		Ft.
	Soil	½
Great Oolite Limestone and Upper Estuarine Beds.	Rubbly marly stone	3
	Limestone	4
	Marl	3
	Limestone	4
	Marl	3
	Limestone	9
	Marl	6
	Blue "callas" (callous clay)	2
	Limestone	6
	Marl	2
	Limestone	11
	Marl "callas"	2
Northampton Sand 11 feet.	Rubbly sand	3
	Red sand	3
	Black sand	5
	Actually 75 feet	66½

Mr. Judge made notes of the rocks passed through as the boring was in progress, but for particulars of the well had to rely upon the memory of the sinkers.

The Northampton sand water was about 6,000 gallons per day, and its rest-level was 12 feet from the bottom of the well.

2. FIRST WELL AND BORING.

Communicated by Mr. R. J. Russel to H. B. Woodward. *See Geol. Mag.*, 1897. p. 102.

From this well the town was for a time supplied.

Yield, plenteous supply from Middle Lias at a depth of a little over (? under) 200 feet.

The well was said to have been sunk 60 ft. 6 in. and then bored.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil - - - - - - - - -	0	6	0	6
Great Oolite Series	Marl - - - - - - - -	3	0	3	6
	Beds of limestone - - - - - -	23	0	26	6
	Callous clay - - - - - - - -	2	0	28	6
	Limestone beds and marl - - - - -	19	0	47	6
	Callous clay - - - - - - - -	2	0	49	6
	Rubble limestone - - - - - - -	3	0	52	6
Northampton Sand 8 feet	Red sand - - - - - - - -	3	0	55	6
	Black sand - - - - - - - -	5	0	60	6
Upper Lias 109 feet	Very hard blue clay - - - - - -	101	0	161	6
	Stone - - - - - - - - -	2	0	163	6
	Blue clay - - - - - - - -	6	0	169	6
Middle Lias	Stone - - - - - - - - -	3	0	172	6
	Sand and hard clay [dry sandy blue clay] -	8	0	180	6
	Mostly sand [very sandy blue clay very dry]-	4	0	184	6
	Very hard stone - - - - - - -	3	0	187	6
	Sand and hard clay [sandy blue clay] - -	6	0	193	6
	Very hard stone - - - - - - -	5	0	198	6
	[Sandy blue clay] - - - - - - -	21	0	–	–

So far as the boring is concerned the above description agrees well with a record by Mr. Judge, who made notes as the work was in progress. Special particulars by him are given in square brackets. Notwithstanding that Mr. Judge's section gives the depth of the well as 66½ feet and Mr. Russel's as 60½, Mr. Judge says the well was actually 75 feet deep, and this is obviously more correct, as matter to follow will make clear.

The well so far described was abandoned and filled up, and a second one was made.

3. SECOND WELL AND BORING.

The second well and boring was commenced in 1874, quite close to the first one ; and the well itself was carried to a depth of 177 feet 6 inches. No record of this second and chief well, which has supplied Brackley with water for a number of years, is to be obtained ; but it was, of course, practically the same as No. 1.

On a recent visit to Brackley the writer was shown a piece of stone which had been treasured for years as a specimen of the rocky bottom of this well. It was undoubtedly the Cephalopoda-bed, always found at the top of the Communis beds of the Upper Lias, which means that the rock-bed was never properly exposed, but only passed through in the boring. Now, if we subtract the 101 feet of clay from 177 feet 6 inches it gives 76 feet 6 inches as the depth to the base of the Northampton sand, which quite agrees with Mr. Judge's contention that the first well was 75 feet deep.

The following particulars of Well No. 2 were given by Mr. Beeby Thompson, "Midland Naturalist," vol. x., p. 206.

Commenced in 1874 ; reached a depth of 177 feet 6 inches. Water then rested at 100 feet from the surface ; that is, the head of water was 77 feet 6 inches.

In 1882 this head was reduced to 41 feet.
In May 1884 this head was reduced to 39 feet 6 inches.
On September 17th, 1884, this head was reduced to 36 feet 6 inches.

The pump discharges 6,000 gallons per hour, and after 6 hours' continuous pumping on September 17th the water level was reduced 11 feet 6 inches; leaving 25 feet in the well.

Water levels. From letter of Sir Geo. Bannerman to Mr. Beeby Thompson. June 1889:—

1885	Ft.	in.
January	37	6
July	32	0
November	34	0

1886	Ft.	in.
February	36	6
September	31	6
November	33	6

1887 (Dry season)	Ft.	in.
January	36	6
August September	28	4
December	28	9

1888.	Ft.	in.
January	30	3
March	33	3
October	29	6
December	33	3

1889.	Ft.	in.
January	35	0
February	35	8
March April May	35	6

4. Third Well.

A third well has recently been made near to the second, from practically the same surface level, and this was dug to a depth of 182 feet 6 inches, and presumably does reach the Marlstone, but no section is available.

B. T.

Brafield on the Green.

One-inch map N.S. 185; Geol. map 52 S.W.; Six-inch map 45 S.E.

1. Well for Public Water Supply.

About 400 feet S.W. from the junction of the Horton and Bedford Roads. Date 1902.

350 feet above Ordnance Datum.

	Ft.
Water level—At commencement of pumping	258
At cessation ,, ,,	251½

Yield 48,000 gallons per diem.

Water regained 258 feet level 3 hours after pumping ceased.

The above communicated by the Local Government Board.

Record of well communicated by Mr. Beeby Thompson from information supplied by Mr. W. Smart, and personal observation.

		Ft.	Ft.
Drift.	Hard chalky clay	30	30
	Rough gravel and sand with some water	3	33
	Hard clay with chalk and flints	40	73
	Dark blue clay—very hard	15	88
	Softer clay and sand mixed	4	92
	Brown sand } Running sand "alive with water"	3	95
Estuarine Beds of Northampton Sand.	White sand } Running sand "alive with water"	7	102
	Rock touched on one side of the well (Northampton sand ?)		

Material of the brown sand is no doubt of Northampton sand derivation, because it contained small lumps of the white Estuarine sands. For this reason, and also the absence of the Upper Estuarine limestone in the clays above, it is included in the Drift.

Wells in the upper part of the village, towards the Bedford road, get their water from the Drift.

2. Well at Co-operative Stores.

Top	348 feet above Ordnance Datum.
Depth about	30 feet.

Evidently reached the gravel and sand bed of the Public well section above.

3. Wells in the lower part of the village, "Lower End," get water from the Great Oolite limestone at a depth of 14 or 15 feet. There may be 7 or 8 feet of water in them.

B. T.

Brampton Ash.

Geol. map 64 ; One-inch map N.S. 170 , Six-inch map 16.
Communicated by Mr. Beeby Thompson.
The HERMITAGE FARM. Harborough Road.
Well. Top about 490 feet above Ordnance Datum.
75 feet deep. All Boulder clay. Not much water.

In the southern part of the village there are various wells deriving their water from the Northampton Sand. They vary in depth from 20 to 30 feet according to situation, the average water level being about 390 feet above Ordnance Datum. According to Mr. J. Wright who sank some of them a common section would be about as follows :—

		Ft.
	Soil - - - - - - - - -	2
Northampton Sand.	Rammel or Kale - - - - - -	8
	Ironstone - - - - - - -	5
	Limestone—hard, bluish, oolitic - -	5
Upper Lias.	Blue Clay - - - - - - -	2
		22

Braunston.

One-inch map N.S. 185. Geol. map 53 N.E. ; Six-inch map 35 S.E.
Communicated by Mr. Beeby Thompson.

Braunston village is supplied with water almost entirely from sand and gravel beds resting on the Lower Lias clay. The depth of the wells and of the water in them being very variable owing to varying height above Ordnance Datum and to variable thickness of the sand. One well seemed to be an exception.

Well and boring at Eastern End and Northern side of street.
Communicated by Mr. J. B. Williams.
Top about 410 feet above Ordnance Datum.

	Well.	Ft.
Glacial.	Sand - - - - - -	28
	Boring.	
Lower Lias.	Clay - - - - - -	7
	Rock- - - - - -	?

Water rose about 9 feet from the rock, and 2 feet into the well, and has continued as a supply.

Brigstock.

Geol. map 64 ; One-inch map New Series 171. Six-inch map 18 S.W.

1. Made by Thrapston Rural District Council. Date 1901.
Sunk 38½ feet. Bored 7 feet 10 inches.
Communicated by Mr. Beeby Thompson.
Height above Ordnance Datum 214 feet. Rest level of water 172½ feet.
Yield 170,000 gallons per day.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Great Oolite limestone.	Soil with some rubbly limestone, practically the base of the limestone - - - - - - -	2	0	2	0
Upper Estuarine Beds 44 ft. 4 in.	Yellow and variegated clay - -	7	6	9	6
	Hard, white, calcareous clay with dark vertical streaks - - -	2	6		
	Yellowish clay, hard, with vertical plant markings - - - -	3	0	15	0
	Hard limestone with numerous oysters and other fossils - - -	0	6		

1. Made by Thrapston Rural District Council—*continued.*

			Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Upper Estuarine Beds 44 ft. 4 in.		Clay, red and sandy, full of oysters	0	3	15	9
		Hard oyster bed	2	0		
		Clay, with numerous oysters, also many Rhynchonellæ	2	0	19	9
		Soft limestone—practically all comminuted shell	1	3	21	0
		Soft ferruginous sandstone with vertical plant remains	0	6		
		Dark blue or purplish clay with vertical stems of plants	5	6	27	0
	Estuarine limestone.	Hard, blue-hearted limestone, ruddy, very compact, with vertical plants and shells	1	0	28	0
		Greenish clay, sandy, crowded with flattened fossils	2	0	30	0
		Dark brown clay, with numerous black stems and vertical plant markings	8	6	38	6
		Bottom of Well.				
		Clay proved on to a hard rock—Lincolnshire limestone?	7	10	46	4

Water broke through the dark brown clay at the side of the well, and stands 4 feet 9 inches in the well; yield 170,000 gallons per day or more.

Now used as public water supply.

2. "Old Dry" Lane; near to the last, No. 1.

Well to cottages, reported to be 70 feet deep, fails in summer. Judging by excavations near, the section must be about as below :—

Top 226 feet above Ordnance Datum.

	Ft.
Soil and clay	6
Great Oolite limestone	8
Upper Estuarine beds	44
Lincolnshire limestone	12
	70

With some two or three exceptions all the wells in Brigstock are fed by the Great Oolite limestone; there is remarkable uniformity of water-level, Nos. 3 and 4 are no doubt influenced by a fault.

Wells to the N.W. of the Main Street.

3. Pump in farmyard. Top 213 feet above Ordnance Datum.

	Ft.
To water	8
Water	12
	20

Hard rock at bottom.

4. Well north-western end of village. Top 201 feet above Ordnance Datum.

	Ft.
To water	18
Water	7
	25

5. Well in Carpenter's yard. Top 186 feet above Ordnance Datum.

	Ft.
To water	11
Water	9
	20

6. Pump in Street, at 178 feet above Ordnance Datum.

Water 2 or 3 feet below the surface.

Mr. Viccars' Well. Top 179 feet above Ordnance Datum.

	Ft.
To water	6
Water	12
	18

8. Well in field to the S.E. Top 176 feet above Ordnance Datum.

	Ft.
To water	4
Water	12
	16

9. Parish pump, corner of roads near to Church. Top 175 feet above Ordnance Datum.

	Ft.
To water	3
Water	3
	6

Wells to the S.W. of main street.

10. Well near western end of village. Top 196 feet above Ordnance Datum. Depth. 20 feet.

11. Well at house near to "Fox and Hounds" Inn, on other side of stream. Top 183 feet above Ordnance Datum.

	Ft.
To water	8
Water	12
	20

Spring into backwater, 171 feet above Ordnance Datum.

12. Well in yard about middle of main street. Top 186 feet above Ordnance Datum.

		Ft.
Great Oolite Limestone.	Shaley oolitic rock (reported)	10 ?
	Hard blue rock (reported)	10 ?
		20

No particulars about water.

13. Well at Mr. Beeby's timber yard, high ground to S.W. Top about 218 feet above Ordnance Datum.

		Ft.
Glacial Beds.	Earth	3
	Red gravel, hard	½
	Sand drift	3
	Clay, with flints	12
		18½

14. 1½ miles N.E. of FARMING WOODS HALL.

Boring made and communicated by Messrs. E. Timmins & Sons, Runcorn. Date, 5th July, 1897 (received).

		Thickness. Ft.	Depth. Ft.
Probably Boulder Clay.	" Oxford clay "	99	99
Great Oolite Limestone.	Foss d[ar]k greystones	20	119
Upper Estuarine Series 40 ft.	D[ar]k green marlstone	6	125
	D[ar]k brown clay	14	139
	Light grey limestone	3	142
	D[ar]k brown clay-	2	144
	Fossiliferous d[ar]k grey limestone	1	145
	Dark brown clay	14	159

14. 1½ miles N.E. of FARMING WOODS HALL—*continued.*

		Thickness. Ft.	Depth. Ft.
Inferior[1] Oolite Series.	Brown stone	7	166
	Light grey limestone	2	168
Upper Lias.	Blue grey shale	82	250
	Grey fossil bed	1	251
	Blue grey shale	23	274

Bringtou.

Geol. map 53 N.E.; One-inch map N. S. 185; Six-inch map 37 S.W.

Well and boring made for the Right Hon. Earl Spencer, K.G. 1892.

Communicated by Mr. Beeby Thompson, *Journal Northants Nat. His. Soc.*, vol. xi, p. 68.

Height above Ordnance Datum 465; rest level of water 118 feet from surface.

Smith's Field, Gawburrow Hill, W. of Great Brington.

Yield equal to about 15,000 gallons a day.

Quality (with copy of Analysis, *see* p. 193).

			Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Northampton Sand.		Soil, reddish sand, and sandstone	9	0	9	0
Upper Lias 180 ft. 1 in.		Blue clay and shale	173	0	182	0
	Communis Beds.	Cephalopoda bed, numerous ammonites	0	7 ?		
		Clay with small oolitic concretion	2	6 ?	184	6
	Serpentinus Beds.	Cephalopoda bed	0	6		
		Clay	1	6	186	6
		Paper shales and fish-bed	2	0	188	6
	Transition Bed ?	Sand	0	6	189	0
Middle Lias.	Rock Bed.	Green rock	2	0		
		Sand	0	6		
		Rock	0	6	192	0
		Blue clay	8	6	200	6
		Rock yielding water	2	0	202	6
		Clay	2	0		
		Rock	2	0	206	9

The water apparently came from the rock at 202 ft. 6 in. The rock-bed did not yield water. The lower 50 feet or so was bored.

Headings have since been made in the well with a floor level 153 feet from the top of the well, for storage purposes only.

Great and Little Brington were formerly supplied by shallow wells. (*See* Dr. S. M. Copeman's Report to Local Government Board, No. 303, 1908.)

Brixworth.

One-inch map N.S. 185; Geol. map 52 N.W.; Six-inch map 31 S.W.

Communicated by Mr. Beeby Thompson.

There are numerous wells and springs in and around Brixworth deriving water from the Northampton Sand. The water-supply and water-level varies much owing to the Northampton Sand having slipped on the Lias clay towards the valleys. This variation will be seen by comparing the wells recorded below.

(S*ee also* Reports to Local Government Board by Dr. H. F. Parsons, 1885, and Dr. S. M. Copeman, 1908.)

1. Spring in VILLAGE STREET: Public. 376 feet above Ordnance Datum.

2. Well to PROPERTY ADJACENT to No. 1.

Top - - - - - - 388 feet above Ordnance Datum.
To water - - - - - - - - 11 feet.

Water from red rock, but not much.

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[1] It is difficult to decide how to group the strata here; they may represent Northampton sand or Lincolnshire limestone, or both.

Six-inch map 38 N.W.

. Well for Cottages just at S.E. corner of WORKHOUSE GROUNDS.

Top about - - -	421 feet above Ordnance Datum.
To base of ironstone -	23 feet.

Very little water.

4. High ground on the NORTHAMPTON ROAD, near to the Workhouse.

Mr. Beeby Thompson, *Journ. Northants Nat. Hist. Soc.*, vol. xii, p. 58.

In April, 1896, a well 32 feet deep had been made, 10 feet in clay, and water-level 12 feet from bottom.

From particulars supplied and his own observations Mr. Thompson made the following notes :—

	Ft.
Ironstone Beds - - - - -	22
Upper Lias - - . - - -	10

5. Mr. Preston's well in field near to FOOTPATH S.E. of the workhouse, on opposite side of road to No. 4.

Top about 433 Feet Ordnance Datum.

		Feet approximate.
Northampton Sand.	Ironstone - - - - - - - -	15
	Exceedingly hard blue rock - - -	3
Upper Lias.	Clay - - - - - - - - -	6
		24

About 11 feet of water.

Burton Latimer.

Geol. map 52 N.W. ; One-inch map N.S. 186 ; Six-inch map 32 N.E.

1. West of BURTON WOLD, 2 miles East of Isham Station. 1901.

Sunk, diam. 5 feet 4½ inches.

Communicated by Mr. W. Keay.

Height above Ordnance Datum 266 feet. Rest level of water about 59 feet from surface.

Yield 12,000 gallons per day from the Northampton Sand.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Boulder Clay.	Drift clay with rounded pebbles and fragments of yellow limestone - - -	14	0	14	0
Great Oolite Limestone (?)	Yellow limestone, "Whitestone," containing small fragments of shells - -	4	0	18	0
	Dark grey clay - - - - - - -	2	0	20	0
	Very fine dark grey limestone, "Bluestone," containing shells - - - - -	6	0	26	0
	Dark grey shale, "Slaty clay," compact *in situ*, but soon disintegrates on exposure	4	0	30	0
	Very hard compact grey limestones, crowded with shells - - - - - -	12	9	42	9
Upper Estuarine Beds (?)	Dark grey clayey limestone - - - -	1	9	44	6
	Hard grey compact limestone - - - -	1	6	46	0
	Compact grey limestone, easily weathers -	2	0	48	0
	Very hard compact sandy limestone - -	1	0	49	0
Northampton Sand. (?)	Loose grey dry sand - - - - - -	2	6	51	6
	Very fine white soft sandstone merging into a fine yellow soft sandstone (water) -	8	0	59	6
	Dark grey fine soft sandstone - - - -	3	6	63	0
	Dark grey very compact heavy sandstone -	8	0	71	0
	Very dark grey compact fine sandstones -	8	0	79	0

1. West of BURTON WOLD, 2 miles East of Isham Station. 1901.—*continued*

			Thickness. Ft.	in.	Depth. Ft.	in.
Upper Lias 182 feet.		Dark blue clay containing small dark concretions	2	0	81	0
		Six-inch Borehole.				
		Blue clay, with iron pyrites in lower part	148	0	229	0
		Three-inch Borehole.				
		Blue clay	20	0	249	0
	Communis Beds	Hard rock	0	2		
		Clay	6	4	255	6
	Serpentinus Beds	Hard rock	0	6		
		Clay	5	0	261	0
Middle Lias.	Rock Bed.	Rock-like stone-dust and small pebbles, some subangular, others fairly round	1	8	262	8
		Clay	14	7		
		Dark grey pebbles, and some quartz pebbles	0	9		
		Blue clay with beds of rock from 1 to 6 inches in thickness, Gryphæa (cymbium ?) occurs near base	21	4	299	4

Headings were made in the grey ironstone 76 feet from top of well. 6 feet by 4½ feet.

2. Well at Burton Latimer WINDMILL (now dismantled).
Communicated by Mr. B. Thompson.
Half a mile N. of village.
Top about 298 feet above Ordnance Datum.

		Ft.
Northampton Sand.	To water	6
	Water	8
		14

3. Well in Mr. Barlow's Field on FINEDON ROAD, near to the parish boundary.
Top about 299 feet Ordnance Datum.

	approximate Ft.
Boulder clay	30
Upper Estuarine beds ? (not actually identified)	10 ?
Lower Estuarine beds (some white sand seen) Grey sandstone Grey ironstone, a little red in places	18½
	58½

Water stands 5 feet 7 inches in well. 1899.

Castor.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 8 S.W.
For Water-supply of Peterborough.
J. Addy, *Proc. Inst. Civ. Eng.*, lxxiv, 147, 1883.

Trial Boring, 1875—no large quantity of water obtained, and boring abandoned.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Surface Soil	3	0	3	0
	Gravel	10	3	13	3
Great Oolite clay.	Clay (mottled)	6	7	19	10
Great Oolite limestone.	Rock (blue in layers)	7	0	26	10
Upper Estuarine.	Clay (black vegetable)	3	3	30	1
	Silt	4	0	34	1
Northampton Sand.	Sand (grey)	15	5	49	6

Trial Boring, 1875—no large quantity of water obtained, and boring abandoned—*continued.*

		Thickness. Ft.	in.	Depth. Ft.	in.
Upper Lias.	Clay (blue)	7	4	56	10
	Rock	2	0	58	10
	Clay (hard blue soapy)	88	6	147	4
	Rock		10	148	2
	Clay (hard slate-coloured)	18	10	167	0
	Rock	1	2	168	2
	Clay (hard slate-coloured)	15	8	183	10
	Rock (whitish)		4	184	2
	Clay (hard slate coloured and streaky)	27	2	211	4
	Shale (rocky)		2	211	6
	Clay (hard slate coloured)	21	11	233	5
	Rock		4	233	9
	Clay	2	8	236	5
	Rock (white)	1	1	237	6
	Clay (hard olive-green coloured and gritty)	6	11	244	5
	Rock (bluish-grey)	2	3	246	8
	Clay (grey, very sandy)	3	10	250	6
	Clay (hard slate-coloured and sandy)	26	6	277	0
	Rock		6	277	6
	Clay (mottled and sandy)	9	0	286	6

Church Brampton.

Geol. map 53 N.E ; One-inch map N.S. 185 ; Six-inch map 37 N.E.

Communicated by Mr. Beeby Thompson.

CHURCH BRAMPTON LODGE—"Cank Farm," well near to Lodge—Top about 272 feet above Ordnance Datum.

			Ft.
Upper Lias.	Communis Beds.	Clay	34
		Fossiliferous rock : Cephalopoda bed with water	1
			35

Plenty of water—rises about 25 feet.

This water probably breaks through from the Marlstone below.

"Chapel and Church Brampton are supplied with spring water pumped by an old water-mill to a reservoir, from which it is distributed by gravitation."—(Dr. S. M. Copeman, Report to Local Government Board, 1908.)

Clapton.

One-inch Map N.S. 171 ; Geol. map 52 N.E ; Six-inch map 27 S.W.

1. Boring made by Messrs. C. Isler & Co., for A. B. Renshaw, Esq., 17th May, 1905.

Communicated by Messrs Rawlence and Squarey.

50 feet of 8½-inch tubes 4 feet 6 inches below surface ; 255 feet of 6-inch tubes, 1 foot from surface.

Water-level 212 feet from surface.

Yield at depth of 248 feet 4 inches, 378 gallons per hour. Water then stood at 114 feet from surface.

		Thickness. Ft.	in.	Depth. Ft.	in.
Soil.	Top Soil	1	6	1	6
Boulder Clay	Yellow clay with stones and knobs of chalk	15	6	17	0
	Boulder clay	99	0	116	0
Oxford Clay and Kellaways Beds.	Light coloured clay	54	6	170	6
	Brown clay and shells	59	0	229	6
	Hard grey sandstone	0	9	230	3
	Grey loamy sand	4	9	235	0
	Blue clay	7	6	242	6
Cornbrash 7 ft. 4 in.	Hard grey sandstone and layer of clay	3	4	245	10
	Hard grey sandstone	4	0	249	10
Great Oolite Clay 7ft 6 in.	Light coloured clay	7	6	257	4

1. Boring made by Messrs. C. Isler & Co., for A. B. Renshaw, Esq., 17th May, 1905—*continued.*

		Thickness. Ft.	in.	Depth. Ft.	in.
Great Oolite Limestone 19 ft. 4. in.	Hard grey sandstone - - - - - -	6	3	263	7
	Light coloured clay - - - - - -	1	3	264	10
	Hard grey sandstone - - - - - -	6	8	271	6
	Light coloured clay - - - - - -	0	10	272	4
	Hard grey sandstone - - - - - -	4	4	276	8
Upper Estuarine Beds.	Dark clay, little sandy - - - - -	0	11	277	7
	Mixture of green clay, brown clay and sand	1	8	279	3

The term "sandstone" has evidently in several instances been applied by the well-borer to limestone.—H. B. W.

1*a*. CLAPTON HALL.

Sunk 100 feet; the rest bored.

Boring made and details communicated by Messrs. Le Grand and Sutcliff 1908.

About 240 feet above Ordnance Datum.

A little water from 278 to 280 feet, rose to 141½ feet from surface.

		Thickness. Ft.	in.	Depth. Ft.	in.
Boulder Clay and Oxford Clay.	Dug well in Drift, etc. (see No. 3) - - -	100	0	100	0
	Blue clay and shale with stones [? cement stones] and fossils - - - - - -	133	6	233	6
Kellaways Beds.	Grey flaky sandstone - - - - - -	1	6	235	0
	Grey sandy loam - - - - - - -	4	6	239	6
	Stiff blue clay, shale, and sandstone - -	8	4	247	10
Cornbrash	Hard grey stone, with thin shale at 251 feet	4	8	252	6
	Grey stone - - - - - - - -	4	6	257	0
Great Oolite Clay.	Dark-coloured clay - - - - - -	3	6	260	6
Great Oolite Limestone.	Hard grey rock - - - - - - -	3	6	264	0
	Grey rock with occasional thin bands of blue clay and fossils - - - - - -	11	6	275	6
	Grey calcareous rock - - - - - -	2	9	278	3
	Grey calcareous rock with thin bands of clay and fossils - - - - - - - -	2	0	280	3
	Grey rock and fossils - - - - - -	2	9	283	0
Estuarine Beds.	Greenish clay, with thin bands of grey stone -	17	0	300	0
	Greenish sandy clay, with bands of shells and thin bands of grey stone and sand - -	23	6	323	6
	Brown clay, grey sand and shells; with pyrites	26	6	350	0
Upper Lias	Dark blue clay, with *Ammonites bifrons* (?) etc., in lower 13 feet - - - -	113	0	453	0

H. B. W.

2. Boring N. of BROOK LODGE. By Mr. Tompkins.

Communicated by Mr. Beeby Thompson from information supplied by Mr. Guy Marsh and others.

Top approximately 230 feet above Ordnance Datum.

Depth - - 202 feet 9 inches.

At 180 feet went through 5 feet of rock (Cornbrash ?), then 6 or 7 feet of clay and some sand (Great Oolite Clay ?), then rock again not pierced (Great Oolite Limestone ?). First water got at 72 feet. Total water about 1,400 gallons per day. Stands 111 feet from the surface—highly saline.

3. Well close to the OLD HALL out-buildings (1908).

Communicated by Mr. Beeby Thompson from information supplied by Mr. Smart and personal observations. No water whatever.

	Ft.
Boulder clay - - - - - - - -	70
Oxford clay - - - - - - - -	30
	100

Collingtree.

Geol. map 52 S.W.; One-inch map N.S. 202; Six-inch map 52 N.W.

Communicated to Mr. Beeby Thompson by Mr. W. Smart.

Well near RECTORY.

		Ft.
	Soil	2
Pre-glacial Sand.	Sticky loam	4
	Sand	14
		20

Water rises 8 feet 6 inches; quantity 150 gallons per hour.

Corby.

Geol. map 64; One-inch map N.S. 171; Six-inch map 17 N.E.

Communicated by Mr. Beeby Thompson.

The wells in Corby derive their water from the Northampton Sand, and naturally vary in depth. Of several examined the depth varied from 26 feet to 39 feet, with depth of water from 2 feet to 5 feet. No section of any one could be ascertained, but the ironstone workings around give a good indication of the characters of the strata, and the succession would be about as follows:—

		Ft.		Ft.
Glacial.	Boulder clay	up	to	10
Northampton Sand.	Lower Estuarine beds	„	„	15
	Ironstone beds	10	„	12
Upper Lias.	Blue clay	2	„	5

Courteenhall.

Geol. map 52 S.W.; One-inch map N.S. 202; Six-inch map 52 N.W.

Communicated by Mr. Beeby Thompson.

From information supplied by Mr. W. Smart, 1901.

1. Well near COURTEENHALL GRANGE.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	6	1	6
Pre-glacial Sands.	Clay and loam, a mixture	5	0	6	6
	Rough sand and gravel	2	0	8	6
	Good clean sand	16	6	25	0

Well stopped in running sand.

Clay at 30 feet down.

2. EAST LODGE, near above.

Well 40 feet deep. Similar section.

Cranford St. Andrew.

Geol. map 52 N.W.; One-inch map N.S. 171; Six-inch map 25 S.E.

Communicated by Mr. Beeby Thompson.

1. The RECTORY WELL.

Top about 263 feet above Ordnance Datum.

Great Oolite Limestone.	Well 30 feet deep. Water rises very little, in small quantity, and comes from a white limestone.

2. RECTORY HILL Well. Further down the slope. Public supply.

Top 238 feet above Ordnance Datum.

Northampton Sand source. 40 feet to the water.

There are various other shallow wells and springs about, some deriving water from the Great Oolite and others from the Northampton Sand. The most important spring, probably, is that known as "Craft's Spring," near to the stream dividing the two parishes.

Cranford St. John.

Geol. map 52 N.W.; One-inch map N.S. 186; Six-inch map 25 S.E.

Wells are fairly numerous on the south side of the stream dividing the two parishes of Cranford St. Andrew and Cranford St. John, mostly no doubt deriving their water from the Great Oolite, but whether from the main limestone bed or the Estuarine beds is uncertain owing to a fault, and probably considerable eastward dip of the beds on one side of it. Some get water from the Northampton sand. A few of the more important wells are mentioned.

1. BARRACK YARD Well, western end of village. Top 231 feet above Ordnance Datum.

To water 9 feet.

2. MR. BATTLE'S WELL. The Brewery. Top 223 feet above Ordnance Datum. Depth 25 feet, with 5 feet of water.

3. MR. BRADSHAW'S WELL (Rectory), opposite CHURCH.

Depth 20 feet.

4. WARR'S WELL AND PUMP. (Supplies 16 houses.) Top 222 feet above Ordnance Datum.

Depth 20 feet.

Dallington.

Geol. map 53 S.E.; One-inch map N.S. 185. Six-inch map 44 N.E.

Communicated to Mr. Beeby Thompson by Mr. "Jack" Pearson, workman for Mr. Henry Green.

Well at Mr. Shuttleworth's near the Harlestone road, East side.

Top approximately 285 feet above Ordnance Datum.

Well 66 feet deep. Nothing but sand or sandstone encountered, excepting about 1 foot 6 inches of blue rock at the bottom, and water came from this in a good stream, rising 9 feet in the well.

All Northampton sand.

This is the character of other wells about.

Deanshanger.

Geol. map 46 N.W.; One-inch map N.S. 202; Six-inch map 61 S.W.

Wells at Little London, in Great Oolite limestone, &c.

22 to 25 feet deep.

A. C. G. C.

Daventry.

One-inch map N.S 185; Geol. map 53 S.E.; Six-inch map 36 S.W.

Communicated by Mr. Beeby Thompson.

Daventry, essentially, stands on the Middle Lias, and the numerous wells in the town derive their water from this formation, but since the wells vary in depth from 30 feet to 60 feet, and the shallower wells are on the higher ground it is obvious that more than one spring in the Middle Lias is utilized. In some parts of Daventry, as in New Street, the Marlstone is near to the surface, and is from 1 foot 6 inches to 2 feet thick; in other parts there is a yellowish or blue clay above this rock.

Previous to 1890 a local water company was established and a reservoir was constructed on the side of Borough Hill, to the south-east of Daventry, a little below the 600 feet contour, water being derived from the Northampton Sand beds capping the hill. This supplied about 100 houses, but was never considered an adequate provision for the whole town.

From 1890 onwards the Borough Council set to work to find a proper source of water for a public supply, and borings were made in different places.

1. MONKSMOOR BORINGS.

In some fields south of Monksmoor Farm, N. of Daventry, 1895-6.

From information supplied by Mr. J. B. Williams, of Daventry.

No. 1.

Top, 372 feet above Ordnance Datum, in old sand pit.

	Ft.
Soil - - - - - - -	1½
Sand - - - - - - -	21
Clay - - - - - - -	1½
	24

No. 2.

Top, 372 feet above Ordnance Datum, in old sand pit.

	Ft.
Soil and gravel - - - - -	3
Sand - - - - - - -	3
Clay - - - - - - -	6
Marl and gravel - - - - -	7
Clay - - - - - - -	1
	20

No. 3.

Top, 375 feet above Ordnance Datum.

	Ft.	in.
Soil and clay - - - - -	1	6
Peat and vegetable matter -	2	6
Clay - - - - - -	2	9
Clay and sand- - - - -	3	9
Sand and mud - - -	5	3
Sand - - - - - -	0	3
Gravel and sand, fine gravel very dirty - - - - -	11	0
Coarse gravel, clean - -	5	0
Clean sand - - - - -	4	0
Clean sand and gravel - -	3	0
Marl and gravel - - - -	0	6
Gravel - - - - - -	0	6
Clay - - - - - -	5	0
Marl - - - - - -	14	6
	59	6

No. 4.

Top, 375 feet above Ordnance Datum.

	Ft.	in.
Clay - - - - - -	17	9
Sand and clay- - - - -	4	9
	22	6

No. 5.

Top, 373 feet above Ordnance Datum.

	Ft.
Soil - - - - - - - -	3
Sand and clay - - - - -	2
Sand - - - - - - - -	1
Sand and marl - - - - -	1
Gravel and mud - - - - -	10½
Blue clay - - - - - - -	2
	19½

No. 6.

Top, 364 feet above Ordnance Datum.

	Ft.
Clay - - - - - - -	7
Sand and clay - - - - -	8
	15

No. 7.

	Ft.
Sand and marl - - - - -	8
Clean sand - - - - - -	3
Sand and mud - - - - -	4
Clay - - - - - - -	4
Sand and mud - - - - -	2
Mud - - - - - - -	6
Clay - - - - - - -	–
	27

No. 8.

Top, 363 feet above Ordnance Datum.

	Ft.
Marl - - - - - - - -	4
Clay and sand - - - - -	8
Sand - - - - - - - -	5
Clay - - - - - - - -	7
Gravel and sand - - - - -	6
Sand and mud - - - - -	2
Blue clay - - - - - -	½
Gravel and mud - - - -	6½
Gravel - - - - - -	1
	40

No. 9.

Top, 377 feet above Ordnance Datum.

	Ft.
Soil, marl, and pebbles - -	8
Sand - - - - - - - -	24
Dirty sand - - - - - -	2
Sand and small pieces of ironstone	9
Blue clay - - - - - - -	–
	43

No. 10. WELL AND BORING.

Well, 20 feet remainder a boring.

Top 390 feet above Ordnance Datum.

	Ft.
Soil, marl, pebbles, &c. - - - - - - -	8
Sand - - - - - - - - - -	32
Sand and small pieces of ironstone - - -	9
Blue clay - - - - - - - - - -	1
	50

The yield of water from No. 10 was 72,000 gallons per day through a 15 in. tube just resting on the clay, the coarser sand and gravel at the bottom acted as a filter in keeping out the fine sand. The water stood 10 feet from the top, and there was no loss of head after two months' sinking and 14 days' trial pumping.

A scheme for the utilization of this as a town supply was formulated, but did not pass the Local Government Board: the water was considered to be too superficial.

Other borings were now made. One was made on Crow Hill to the S.E. of Daventry, not far from "Burnt Walls," on the advice of a water-diviner. It went down 100 feet, and some rock was encountered, but no water.

Another boring was made on Coventry Hill to the N.W. of Daventry, a little above "Pope's Well," at about 522 ft. above Ordnance Datum; but no quantity of water was obtained.

Still another boring was made near Dane Holme to the N. of Daventry. Starting at about 520 ft. above Ordnance Datum, it went down 120 ft., but no water of consequence was found.

Ultimately, in 1902, a good supply of water was found in the parish of Dodford, near to Newnham Grange, and a scheme for its utilization was completed in 1904, a service reservoir holding 100,000 gallons being constructed on Borough Hill.

2. DANE HOLME, a little N. of Daventry.

Well. Probable section.

Top about 516 feet above Ordnance Datum.

Boulder clay Gravel	35
Middle Lias beds	30
	65

Desborough.

Geol. map 64; One-inch map N.S. 170; Six-inch map 16 S.E.

Communicated by Mr. Beeby Thompson.

1. Well for Public Supply on Braybrook Road, just beyond the town.

Top, 453·5 feet above Ordnance Datum.

Actual section not known apparently, but is Boulder clay resting on the Northampton sand.

	Ft.
Total depth of well	44
Depth to base of heading, which is practically the base of the Northampton sand	41

2. Boring at 459 feet above Ordnance Datum.

A boring in the northern corner of the field in which the reservoir is situated, 53 feet deep, is said to have given 15 feet of rock (Northampton sand) under Boulder clay.

3. Boring at 458 feet above Ordnance Datum.

A boring in the south-western corner of the same field, 53 feet deep, gave no rock whatever. It is said that "the two clays came together" *i.e.*, the Boulder clay and Upper Lias clay. It might have been all Boulder clay.

The total thickness of the ironstone series hereabouts (not all workable) is estimated at 21 feet.

See also Dr. W. W. E. Fletcher's Report to Local Government Board, 1895.

Wells and springs in the southern and south-eastern part of the town, and the fields beyond in these directions, give a much lower water level than those in the upper part of the town, owing to slipping of the water-bearing bed on the clay, the difference amounts to more than 60 feet in two cases.

4. Trial Well.

South-west of Desborough, in field near to HALL FARM.
Top 358·68 feet above Ordnance Datum.
Observations of depths, &c., by Mr. J. Diver, Surveyor.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Upper Lias.		Blue clay with very few fossils	145	0	145	0
	Communis Beds.	Cephalopoda bed, typical, somewhat oolitic	0	9		
		Fossiliferous clay	10	0	155	9
	Serpentinus Beds.	Cephalopoda bed, hard argillaceous limestone, somewhat oolitic	1	6		
		Clay	1	10	159	1
Middle Lias.		Rock; upper part a conglomerate of odds and ends, broken belemnites and other fossils, small pebbles, and iron pyrites. Lower part a more homogeneous argillo-calcareous rock.	0	4	159	5
		Clay	1	2	160	7
		Rock much like above	0	1½		
		Sandy micaceous clay	4	0	164	8½
		Boring somewhat lower through clays	20	0 ?		

No water of any consequence was found. There was no true Middle Lias rock-bed. The remarkable thing about this well is the great thickness of Upper Lias indicated. Unless there is a "fault," or local fold of the strata, of which there is no evidence, the Upper Lias at Desborough is about 212 feet thick; a result entirely unexpected.

Doddington.

See p. 102.

Dodford.

One-inch map N.S. 185. Geol. map 53 S.E.; Six-inch map 43 N.E.

1. Well for the Water Supply of Daventry.

Communicated to Mr. Beeby Thompson by Mr. J. B. Williams, Daventry.

Top 396 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
Upper Lias.	Soil and marl	1	0		
	Yellow clay	8	3		
	Yellow sandy rock	11	3		
	Blue clay with cement stones	4	6		
Middle Lias.	Rock	3	3		
	Clay	6	6		
	Rock	3	0	37	9
	Clay (boring) about	50	0	87	9

Water-level 9 feet 3 inches from top. Water yield in February, 1901, 75,000 gallons per day. Later increased to 150,000 gallons or more by headings. Water comes from the top rock of the Middle Lias, the Marlstone.

2. Well near to the Railway.

Made by the Engineers for the Railway, 1886.

Communicated by Mr. Beeby Thompson from account given by the well-sinkers.

		Ft.	in.	Ft.	in.
Middle Lias.	Soil and light coloured clay Hard bed—soft and sandy	15	3		
	Micaceous clay Hard bed	4	9		
	Clay Hard bed	7	0		
	Light coloured micaceous clay, many fucoids Hard bed yielding water	8	0	35	0

Duston.

Geol. map 53 S.E. ; One-inch map N.S. 185 ; Six-inch map 44 N.E.

Communicated by Mr. Beeby Thompson.

1. Well on Hopping Hill.

From information supplied by Mr. J. J. Watkins and comparison with sections around.

Top about 335 feet above Ordnance Datum.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Great Oolite.		Limestone	6	0	6	0
Upper Estuarine 27 feet.		Blue clay full of shells	12	0	18	0
	Estuarine limestone.	Limestone—two layers of blue stone exceedingly hard	4	0	22	0
		Blue clay	11	0	33	0
Northampton sand, including Lower Estuarine and Ironstone beds, 75 feet.		White sand	7	0	40	0
		Red stone, not bottomed	68	0	108	0

The ironstone is much jointed ; a great crack on the W. side. Cracks extend upwards 8 or 9 feet. Air sometimes comes in puffs from the great crack sufficient to blow out a candle Good supply of water.

2. Wells near to cottage some 300 yards N.W. of the brickyard on Hopping Hill.

(1) Top 302 feet above Ordnance Datum.

To water 40 feet.

(2) Top 286 feet above Ordnance Datum.

To water 25 feet.

Northampton Sand Waters.

3. New Duston.

Well Mr. Botterell's Farm, ¼ mile S. of New Duston.

Top 320 feet above Ordnance Datum.

	Ft.
To water	24
Water	6
	30

4. On the high ground between Old Duston and New Duston, in a field known as Old Close, at about 369 feet above Ordnance Datum, a trial well was made some years back by Mr. Watkins, and was abandoned after passing through 40 feet of clay (Boulder clay?).

The whole of the wells in Old Duston village derive their water from the Northampton sand, at various depths according to the situation of the well.

5. At the north-western end, eastern side of main road, two wells situated at about 325 feet and 317 feet above Ordnance Datum, respectively, were 45 feet and 33 feet deep ; in the deeper of these the well went 6 feet into the clay, and in the second one, clay was not reached but the water stood 5 feet 9 in. in the well

6. In three wells in the upper part of the main street (tops 307 to 314 feet above Ordnance Datum) the water stands from 4½ to 7 feet from the surface.

7. In a well up Squirrel Lane (top 325 feet above Ordnance Datum) the water stands about 15 feet from the surface.

8. The School well (top 311 feet above Ordnance Datum) is 30 feet to the water.

9. A well in the churchyard (top 306 feet above Ordnance Datum) is 21 feet to the water.

In the extreme eastern end of the village the water level is 3 feet below the surface (surface 292 feet above Ordnance Datum.)

Duston is now supplied with water by the Northampton Corporation. An electric pump situated at the turn of the road to Duston from the Weedon road receives water from the town mains and delivers it into a service reservoir situated on the high ground between Old and New Duston.

Earls Barton.

Geol. map 52 N.W. ; One-inch map N.S. 186 ; Six-inch map 46 N.W.

Communicated by Mr. Beeby Thompson.

All the wells in and immediately around Earls Barton derive their water from the Northampton Sand. In the dip towards the eastern side of the village, water bubbles up out of the ground.

At Downthorpe End to the east, some wells made a few years back, one about 20 feet deep, and one of these gave a section as below :—

Top about 289 feet above Ordnance Datum.

		Ft.
Northampton Sand	Ironstone rock - - -	14
Upper Lias.	Blue, micaceous clay - -	6
		20

About half-a-mile further eastward is a pumping station for the public water-supply of Earls Barton. The surface-level is about 290 feet above Ordnance Datum, and the well 22 feet deep. This yielded 96,000 gallons per day when first made, but rapidly declined to about 5,000. A second pumping station has been installed rather less than half-a-mile still further eastward, to pick up water feeding and previously running to waste from Debdale Spring.

East Haddon.

Geol. map 53 N.E. ; One-inch map New Series 185 ; Six-inch map 37 N.W.

"At East Haddon water is pumped from a spring to a reservoir near the school, from which it is distributed to standpipes in the village. The water is raised by means of rams driven by the water of a neighbouring stream."—(Dr. S. M. Copeman, Report to Local Government Board, 1908.)

Communicated by Mr. Beeby Thompson, mostly from information given by Mr. Sodin, East Haddon. 1896.

1. East End. Well in Mr. Seamark's Garden.

	Ft.
To water - - - - - -	10
Water - - - - - -	4½
	14½

Cut through hard ironstone, very regular in constitution.

2. Mr. Snelson's Well.

	Ft.
To water - - - - - -	11
Water - - - - - -	3
	14

3. Mrs. Johnson's Well.

	Ft.
To water - - - - - -	11
Water - - - - - -	2
	13

Water rises much higher after winter rains.

4. Mr. Guthrie's Stable Yard.

Well 30 to 35 feet deep.

5. Nurse's Cottage. First house W. of the Church.

	Ft.	in.
To water - - - -	12	10
Water - - - - - -	6	6
	19	4

Probably all Northampton Sand, though there are gravel beds, which might yield water to wells.

6. Well at the WINDMILL, at angle made by Long Buckby and Ravensthorpe Roads, towards Buckby Folly.

Top about 553 feet above Ordnance Datum.

	Ft.
To water - - - - - -	44
Water - - - - - - -	3
	47

Rammel (sandy ironstone) right to the bottom—no clay reached; very regular and good supply of water.

7. Well at MR. DRAGE'S FARM, near to the Windmill.

	Ft.
To water - - - - - -	49
Water - - - - - -	4
	53

8. Well made at MR. HIRSEY'S FARM, near to Mr. Drage's, in 1894.

Went down 200 feet, mostly clay, but no water was found, and the well was filled in again.

Etton.

Geol. map 64.; One-inch map New Series 158; Six-inch map 3 N.W.

1. Boring. 139 feet deep into Lincolnshire limestone.

Yield 211,320 gallons per day. Water-level 26 feet above surface of ground (25·3 feet Ordnance Datum).

2. Boring. 144 feet deep. Yields 172,440 gallons daily. Water rises 26 feet above surface of ground.

3. Boring. 142 feet deep, into Lincolnshire Limestone. Yield 777,320 gallons daily. Water rises 26 feet above level of ground.

Boring No. 1.

Made and communicated by Mr. J. E. Noble. 1901.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Fen deposits.	Soil - - - - - - - - - -	2	6	2	6
	Gravel - - - - - - - - -	3	4	5	10
Great Oolite Clay 17 ft. 2 in.	Hard shale - - - - - - -	3	2	9	0
	Clay - - - - - - - - - -	14	0	23	0
Great Oolite Limestone 15 ft. 2 in.	Stone and clay - - - - - -	5	3	28	3
	Rock- - - - - - - - - -	9	11	38	2
Upper Estuarine Series 35 ft. 5 in.	Clay - - - - - - - - - -	3	0	41	2
	Rock- - - - - - - - - -	1	0	42	2
	Clay - - - - - - - - - -	22	5	64	7
	Grey marl - - - - - - -	9	0	73	7
Lincolnshire Limestone.	Rock - - - - - - - - - -	65	6	139	1

Boring No. 2.

Communicated by the Local Government Board.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Fen deposits.	Top soil - - - - - - - -	2	0	2	0
	Gravel - - - - - - - - -	1	0	3	0
Cornbrash 6 ft.	Stone - - - - - - - - -	6	0	9	0
Great Oolite Clay 15 ft. 5½ in.	Clay- - - - - - - - - -	3	4	12	4
	Clay and stone - - - - - -	7	0	19	4
	Clay - - - - - - - - - -	3	3½	22	7½
	Stone and clay - - - - - -	0	6	23	1½
	Clay - - - - - - - - - -	1	4	24	5½

Boring No. 2—*continued.*

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Great Oolite Limestone 13 ft. 8 in.	Rock	12	4½	36	10
Upper Estuarine Series 29 ft. 2½ in.	Clay	3	0	39	10
	Rock	0	6	40	4
	Sand, light grey	2	6	42	10
	Clay	11	8	54	6
	Stony clay	2	3½	56	9½
	Sandy clay	5	6	62	3½
	Loose clay	3	9	66	0½
Lincolnshire Limestone.	Rock (water-bearing)	78	7½	144	8

Boring stopped.

N.B.—The three boreholes are near together, but the stopping of the flow from one of them did not increase the flow from the others. No. 3 had much the largest flow, although only 6 in. in diameter (? did the water of all the boreholes rise to the same height above the ground). The yield varies very little between summer and winter.—H. F. P.

Boring No. 3.

Made by Mr. J. E. Noble, Thurlby, near Bourne, 1902.

Communicated by Mr. Henry Preston, F.G.S.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift.	Soil	2	5	2	5
	Gravel	2	0	4	5
Cornbrash 5 ft. 6 in.	Stone	5	6	9	11
Great Oolite Clay 18 ft. 9 in.	Clay	13	6	23	5
	Rock	1	0	24	5
	Stone and clay	1	8	26	1
	Rock	0	10	26	11
	Clay	1	7	28	6
Great Oolite Limestone 11 ft. 11 in.	Rock	9	3	37	9
	Sand and Stone	2	8	40	5
Upper Estuarine Series 32 ft. 6 in.	Clay (sandy)	3	0	43	5
	Clay	5	6	48	11
	Clay and Stone	9	0	57	11
	Clay	6	0	63	11
	Bind	9	0	72	11
Lincolnshire Limestone.	Rock	69	7	142	6

Water found at 34 feet, 83 feet, and 110 feet.

See also Analysis by Dr. J. C. Thresh.

4. Etton Vicarage.

Made by Mr. J. E. Noble, Thurlby near Bourne, 1901.

Communicated by Mr. Henry Preston, F.G.S.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift.	Soil	1	6	1	6
	Stone	0	6	2	0
	Gravel	11	0	13	0
Kellaway's Beds.	Clay	1	0	14	0
	Dark grey sand	6	0	20	0
	Clay	13	1	33	1
Cornbrash.	Rock	7	6	40	7
Great Oolite Clay.	Clay	14	6	55	1
Great Oolite Limestone.	Rock	12	4	67	5
Upper Estuarine Series 38 ft. 5 in.	Clay	3	0	70	5
	Rock	1	6	71	11
	Clay	26	2	98	1
	Bind	7	9	105	10
Lincolnshire Limestone.	Rock	13	5	119	3

Everdon.

Geol. map 53 S.E.; One-inch map N.S. 202; Six-inch map 43 S. W.

Communicated by Mr. Beeby Thompson.

1. Some half-dozen wells at LITTLE EVERDON derive their water from one of the hard beds of the Middle Lias, the rest-level of the water being just about the same height above Ordnance Datum, viz., 363 feet in each, though the depths vary from 35½ feet to 0 feet (a freely running spring).

2. New Wells. LITTLE EVERDON (1906).

West side of Village.

First trial well. Top about 406 feet above Ordnance Datum.

		Thickness. Ft.	in.	Depth. Ft.	in.
Middle Lias.	Soil and sandy marl, approaching a sandstone	6	0	6	0
	Rock:—red, almost an ironstone, highly micaceous	0	9	6	9
	Sandy marl	2	3	9	0
	Blue shale—ferruginous	6	0	15	0

New well, about 140 yards away, commencing, about 2 feet lower level than bottom of last viz., about 389 feet above Ordnance Datum.

		Thickness. Ft.	in.	Depth. Ft.	in.
Middle Lias.	Turf and soil, and whitish or rather ruddy, highly micaceous, sandy clay	11	0	11	0
	Compact, blue-hearted limestone, rather mottled, with numerous rounded (water-worn) nodules or pebbles. Very fossiliferous	4	0	15	0
	Blue or grey micaceous clay, less sandy than higher beds	5	0	20	0
	Rock; grey and ruddy, containing fossils and much comminuted shell	1	0	21	0
	Water found here. Same level as the other wells around.				
	Bluish grey clay, very sandy, with comparatively little mica	5	0	26	0
	Rock—hard, bluish grey, micaceous and sandy, in two courses of about 2 feet each	4	0		
	Sandy micaceous clay, hard, numerous red joints. *Water* comes from these joints.	10	0	40	0
	Rock—hard, bluish grey	4	0		
	Hard micaceous shale	4	9	48	9
	Rock—hard grey limestone, with patches of mottled rock, green with yellow inclusions. Large rounded masses of argillaceous limestone of a lighter colour (pebbles)	1	0 ?	49	7½ total depth.
	Water. Not cut through.				

The Middle Lias here is obviously more than 67 feet thick.

Eye.

3 miles N.E. of Peterboro.

Geol. map 64; One-inch map N.S. 158; Six-inch map 9 N.W.

Made by Mr. J. E. Noble, Thurlby, near Bourne, 1899.

Communicated by Mr. Henry Preston, F.G.S.

Water stands 20 feet below the surface.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Soil	1	0	1	0
	Gravel	2	0	3	0
Oxford Clay and Kellaways Rock.	Clay	50	0	53	0
	Sandy rock	5	0	58	0
	Clay	9	0	67	0
Cornbrash.	Rock	7	9	74	9

3 miles N.E. of Peterboro—*continued.*

		Thickness. Ft.	in.	Depth. Ft.	in.
Great Oolite Clay and Limestone.	Black clay	4	3	79	0
	Green clay	4	0	83	0
	Rock	2	0	85	0
	Clay	3	0	88	0
	Rock	7	6	95	6
Upper and Lower Estuarine and Northampton Sand.	Clay	27	6	123	0
	Grey sand	18	0	141	0
	Black sand	4	0	145	0
	Rock	–	9	145	9
Upper Lias.	Clay	14	3	160	0

A little water was obtained from the sand bed above the Upper Lias.

A "water diviner" had promised a good supply at 60 feet, but none was obtained before the Estuarine sands were reached.

Finedon.

Geol. map 52 N.W.; One-inch map N.S. 186; Six-inch map 39 N.E.
Communicated by Mr. Beeby Thompson.

New well for public water-supply, by side of Wellingborough road, rather more than ¼ of a mile from the Ise brook.

Top 190 feet above Ordnance Datum.

				Thickness. Ft.	in.	Depth. Ft.	in.
Upper Lias.		Blue clay—few fossils		114	9	114	9
	Communis beds.	Cephalopod bed—hard, grey, argillo-calcareous rock, full of fossils		1	9	116	6
		Water came from this at rate of 500 gallons per day, rising to top of well if left long enough.					
		Grey clay, with a few oolitic concretions		4	0	120	6
	Serpentinus beds.	Cephalopod bed—hard, grey, argillaceous stone with Oolitic concretions		0	8		
		Stiff blue clay, with Oolitic concretions and few fossils		5	10	127	0
		Cephalopod bed with large ammonites	These formed one block of stone.	1	0		
		Fish-bed—hard and calcareous		1	0	129	0
Middle Lias.		Rock-bed, essentially a conglomerate		1	0	130	0
		Blue clay		6	0		
		Hard shale—brickwork of heading on this up to the rock-bed		1	0	137	0

Yield of water from the rock-bed 100,000 gallons per day, increased to 140,000 ? gallons per day by a heading. Water rises to within 40 feet of the top=89 feet head.

2. A trial well on the Burton Latimer Road some 300 yards from town, made in 1895 ?

Mr. Beeby Thompson in *Journ. Northants Nat. Hist. Soc.*, vol. xii, p. 56.

Sunk to depth of 60 feet. Top 285 feet above Ordnance Datum. Water-level 18 feet 6 inches from bottom.

Penetrated Great Oolite Limestone with *Rhynchonella concinna.*	45 feet ?
Upper Estuarine Beds. Clays with many *Ostrea.*	
Lower Estuarine Beds	
Ironstone Beds. Brown and green ironstone.	
Junction Bed. A thin bed with pebbles and bored nodules.	
Upper Lias Clay	15 feet ?
	60

Floore.

Geol. map 53 S.E.; One-inch map N.S. 185; Six-inch map 44 S.W.
Communicated by Mr. Beeby Thompson.

1. Well (Mr. Champion's) EAST END OF FLOORE, North side of road.
(From information supplied by Mr. W. Smart).
Top 303 feet above Ordnance Datum.

		Ft.
Middle Lias.	Clay	15
	Rock	6
	Clay	14
	Rock - 2 ft. to	3
		38

Bottom rock—hard, blue, parts of it a conglomerate; probably basement bed of the Middle Lias. Water rose 10 feet from 38 feet; yield 40,000 gallons per day.

2. "TOWN WELL."

Top about 298 feet above Ordnance Datum.

	Ft.
To water	27
Water - about	9
	36

Evidently same source of water as No. 1.

Spring in valley to the south of village at practically the same level.

Six-inch map 43 S.E.

3. Well, last house on N. side of Weedon Road, towards Weedon before turning corner (Mr. Judkins.)

Top about 364 feet above Ordnance Datum.

		Ft.
Boulder Clay ?	Clay	20
A little Upper Lias, but mostly Middle Lias.	Clay and rock, 3 or 4 hard beds passed through 3 or 4 feet thick	63

At each hard bed, excepting the last one, they lost the water, but recovered it again lower down. Bottom spring good, but water did not rise more than 2 feet 6 inches.

A spring in the village to the south has approximately the same water-level.

4. Well to new House (1907) corner of roads, top of FLOORE HILL (Mr. Smith's).
Top approximately 361 feet above Ordnance Datum.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Boulder Clay.	Soil and clay with stones	21	0	21	0
	White gravel	0	3		
	Clay with some large stone-boulders	8	9	30	0
Middle Lias.	Hard blue rock, ruddy at joints, scarcely any fossils	2	0	32	0
	Light coloured, ruddy, micaceous clay	5	6	37	6
	Hard, blue-hearted rock, red joints	4	0	41	6
	Light coloured, ruddy, micaceous marl	11	6	53	0
	Hard blue-hearted rock	4	0	57	0
	Micaceous marl as before, excepting for 2 or 3 feet at bottom, where ordinary blue clay	23	0	80	0
	Hard rock with *water*, only just uncovered, water rises a little only.				

Water lost at each hard bed and recovered below, excepting the last one.

5. New Well, north-westerly corner of same field as last (Mr. Stevenson's).

FLOORE HILL.

Record supplied by Mr. W. Smart, of Denton, the contractor.

Top, 384 feet above Ordnance Datum.

		Thickness. Ft.	in.	Depth. Ft.	in.
Post-Glacial Gravel	Red sandy gravel	17	3	17	3
Upper Boulder Clay, 37 ft. 3 in.	Chalky clay	26	0	43	3
	Dirty gravel with *water*	1	3	44	6
	Clay and sandy loam Gravel with *water* Clay	9	0	53	6
	Gravel with *water*	1	0	54	6
Upper Lias. Communis Beds.	Cephalopoda - bed, rock with numerous fossils	1	6	56	0
	Clay	5	0	61	0
Middle Lias.	Rock—a ruddy stone	6	0	67	0
	Brown, micaceous, sandy shale (with stone beds)	33	0	100	0
	Blue, micaceous clay, peculiarly unfossiliferous	10	0		
	Hard rock, yielding water—only just reached			110	0

There was nothing that could be recognised as the Marlstone rock-bed, which is singular considering its good development in the district near. Loss of water, and recovery below, observed in this as in some other wells.

Furtho.

Two miles N.W. of Stony Stratford.

MANOR FARM.

One-inch map N.S. 202 ; Geol. map 46 ; Six-inch map 61 N.W.

Communicated by Mr. A. C. G. Cameron.

Nos. 1 and 2.

		Thickness. Ft.
Sunk.	Boulder clay[1]	25
Bored.	Clean clay	75
		100

No rock and no water.

No. 3.

Sunk.	Boulder clay	10
	Sand and water.	

Spring led in pipe from close to No. 3, to House.

Gayton.

Geol. map 53 S.E. ; One-inch map New Series 202 ; Six-inch map 51 N.E.

Boring made by Northampton Waterworks Co.

Communicated by Mr. Henry J. Eunson, "The Range of the Palæozoic Rocks beneath Northampton." *Quart. Journ. Geol. Soc.* Vol. xl., pp. 482 to 496.

Rearranged by Mr. Beeby Thompson.

Height above Ordnance Datum 282. Rest level of water 170 feet above sea-level.

Yield 100,000 gallons per day, or less, of salt water from the Trias.

		Thickness. Ft.	in.	Depth. Ft.	in.
Recent.	Surface soil	1	0		
	Alluvial clay, with stag's antler	7	0	8	0
Upper Lias.	Shale with fragments of fish-bed	0	4	8	4
Middle Lias 100 ft. ?	Rock-bed	2	8	11	0
	Clay	2	8	13	8
	Limestone with *Protocardium*	4	4		
	Clay	7	0	25	0

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[1] *See* also "Pre-glacial Valleys in Northamptonshire" by Beeby Thompson, F.C.S., F.G.S. *Journ. Northampton. Nat. His. Soc.*, vol. ix., 1896–7, p. 49.

Boring made by Northampton Waterworks Co.—*continued.*

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Middle Lias 100 ft. ?		Rock	2	3		
		Sandy clay, very micaceous	6	6		
		Rock	0	9	34	6
		Micaceous clays, etc.[1]	73	10 ?	108	4
Lower Lias 472 ft. 8 in. ?		Clays and stone beds. No accurate record kept	472	8 ?	581	0
Rhætic 36 ft.	White Lias.	Hard white limestone, with pyrites	1	0	582	0
		Sandy vein, with reptilian bones	0	6		
		Dense, hard, white limestone	0	9		
		Sandstone, with limestone bands	2	3	585	6
		White crystalline limestone	2	6		
		White limestone with dark streaks	0	6		
		Dense concretionary limestone	6	6	595	0
	Black Shales	Green shale	7	0		
		Grey shale	0	6		
		Brown shale, with green bands	4	6	607	0
		Soft green marly shale	4	0		
		Hard green marl false-bedding, very conspicuous	2	6		
		Black shales, pyritous, with *Avicula contorta*, etc.	3	6	617	0
		Slightly eroded surface.				
Trias 82 ft.	Grey marls? 6 feet	Grey marl, with bands of gritty sandstone	3	0		
		Cream-coloured, conchoidal marl	3	0	623	0
	Keuper, 53 ft. 6 in.	Red and green mottled marls	3	0 ?		
		Red marl	4	0 ?		
		Brown sandstone	4	0 ?		
		Red marl	3	0 ?		
		Brown marl	0	6 ?		
		Band of hard sandy limestone	1	0 ?		
		Red and green mottled sandstone	2	6 ?		
		Green and yellow sandstone	2	0 ?	658	0
		Hard white sandstone, with pyrites	1	0		
		Fine-grained green sandstone	0	6		
		Green sandstone (odour of sulphuretted hydrogen when broken)	0	6		
		Green sandstone with much iron pyrites	1	0		
		Green sandstone, free from iron pyrites	5	0	666	0
		Yellow sandy marl	1	0		
		Grey sandstone	1	0		
		Light-coloured sandstone, with marly bands	4	0	672	0
		Red marl	1	0		
		Yellowish-green sandy marls	2	0		
		Red marl	1	6	676	6
	Littoral deposits, 22 ft. 6 in.	Brown sandstone with carboniferous limestone fossils	0	6	677	0
		Blocks of limestone in green sandy matrix	1	6		
		Limestone, with polyzoa, etc.	2	0		
		Hard brown limestone	0	6	681	0
		Green and brown limestone and sandstone	1	6		
		Fragmentary limestone in sandy matrix	7	0	689	6
		Green and brown marl, much disturbed	3	0		
		Red, green, and black sandy marls	3	6		
		Black shale on an eroded surface of Carboniferous Limestone[2]	3	0	699	0

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[1] This is only estimated from the fact that *Ammonites capricornus* was found below, and the probability that the Middle Lias here is about 100 feet thick.

[2] Depth is correct; thicknesses uncertain owing to wearing away of cores during boring.

Old Land Surface dipping at an angle of 45° to 50°, direction unknown.
417 feet below sea-level.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Lower Carboniferous, 190 feet.	Shales, 79 feet.	Brown limestone, with eroded surface	1	0	700	0
		Hard dark shale - - - - -	6	0		
		Light brown limestone - - - -	0	6		
		Green sandy shale, with *Syringopora*	5	6	712	0
		Hard indurated shale - - - -	1	0	–	–
		Green shale - - - - - -	6	0	719	0
		White, impure limestone, jointed, with veins of calcite and fossils -	2	6		
		Dark brown shale—Fireclay - -	1	6	723	0
		Impure sandy limestone - - -	7	6		
		Hard, green, sandy shale with fossils	10	6	741	0
		Limestone - . - - - -	0	6		
		Green shale, with fossils - - -	1	6		
		Impure greenish limestone - -	3	6		
		Green sandy shale - - - -	2	6	749	0
		Limestone - - - - - -	1	0		
		Dark brown shale—Fireclay - -	2	6		
		Impure limestone - - - -	1	0		
		Hard, black, bituminous shale -	3	0		
		Sandy vein—Annelid tracks - -	0	6	757	0
		Dark shale - - - - - -	2	6		
		Softer shale, with fossils - - -	3	0		
		Limestone with bituminous veins -	4	0	766	6
		Green shale - - - - - -	9	0		
		Green shale, with fossils - - -	0	6		
		Limestone - - - - - -	0	6		
		Green shale - - - - - -	2	6	779	0
		Decided change takes place here.				
	Sandstones, 40 feet.	Hard white crystalline sandstone -	2	0 ?	780	0
		Green sandstone. Fossils - -	1	0 ?		
		Fine gritty sandstone, with a vein of brown sandstone at base - -	2	6 ?		
		Hard white sandstone, with vein of calcite - - - - - - -	0	9 ?		
		Coarse gritty sandstone, with fish remains - - - - - -	0	6 ?		
		Coarser grit, with well-rounded pebbles of quartz ½ inch in diameter	0	9 ?		
		Coarse grey sandstone - - - -	4	0 ?	792	0
		Grey micaceous sandstone, with plant remains - - - - -	6	6 ?	806	0[1]
		Hard crystalline sandstone - -	1	0	807	0
		Dark grey sandstone, with annelid tracks, etc. - - - - - -	1	0		
		Red and yellow sandstone - -	9	0 ?	817	0
		Red and green sandstone, fissured -	1	0	818	0
	Marls and Sandstone, 71 feet.	Chocolate coloured marl - -	?	?		
		Dark green marl - - - - -	?	?		
		Red sandstone and marl ; fossils -	?	?	847	0
		Red and green marl, with sandy beds - - - - - - - -	34	6	881	6
		Blue sandy marl, with coniferous wood - - - - - -	4	6	886	0
		Grey-bluish sandstone, with plant remains - - - - -	3	0	889	0
Old Red Sandstone ? 105 feet.		Brown marl, with septarian veins replaced by sandy infiltration -	11	0	900	0
		Red marl, with sandy layers -	18	0	918	0
		Fine-grained red and yellow sandstone - - - - - - -	12	0	930	0
		Red sandstone, moderately compact : indications of stratification at 88° to axis of the core	1	0	931	0

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[1] A good deal of these sandstones and grits was ground away in the boring, so that the thickness of each is only approximate.

Boring made by Northampton Waterworks Co.—*continued.*

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Old Red Sandstone? 105 feet.	Coarse, purple, quartzose rock, some of the grains containing abundant minute cavities and some bubbles	1	6		
	Greenish quartzose grit; cavities rather more numerous. Bubbles occasionally present	1	0	933	6
	Red marl, with red and white sandstone bands	8	6	942	0
	Moderately coarse grit, here and there a quartz pebble as large as a pea. Cavities abundant in the quartz and moving bubbles not infrequent. Cement: impure calcite	4	0	946	0
	Red and white sandstone, with several layers of marl	12	0		
	Pale green calcareous grit	1	0	959	0
	Red and grey sandstone, with marl and septaria	30	6		
	Hard grey sandstone, fissured	1	6	991	0
	Red Marl	3	0	994	0

712 feet below Ordnance Datum.

Glinton.

800 yards north of Railway Junction. 3 miles S.E. of Market Deeping.
Geol. map 64; One-inch, 158; Six-inch, 3, S.W.
Made by Mr. J. E. Noble.
Communicated by Mr. Henry Preston.
Water overflows 30,700 gallons per hour.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Oxford Clay and Kellaways Beds.	Clay	7	0	7	0
	Sand and stone	3	3	10	3
	Stone	3	6	13	9
	Sand and stone	7	3	21	0
	Clay	9	3	30	3
Cornbrash	Rock	6	0	36	3
Great Oolite Clay. 13 feet 5 inches.	Clay	7	3	43	6
	Hard grey sand	1	0	44	6
	Clay	2	6	47	0
	Rock	0	6	47	6
	Clay	2	2	49	8
Great Oolite Limestone 11 feet.	Rock	1	4	51	0
	Clay	0	6	51	6
	Rock	9	2	60	8
Upper Estuarine Series 25 ft. 4 in.	Clay	14	10	75	6
	Clay and stone	8	6	84	0
	Clay	2	0	86	0
Lincolnshire Limestone.	Rock	51	9	137	9

2. Seven-inch boring at GLINTON, near the church.
Water rises 17 feet above ground.
Yield, very strong supply of water.

		Ft.	in.	Ft.	in.
Fen deposits	Soil and gravel	1	0	1	0
Oxford Clay and Kellaways Beds.	Clay	11	0	12	0
	Rock	11	2	23	2
	Clay	7	6	30	8
Cornbrash	Rock	7	4	38	0
Great Oolite Clay	Clay	12	8	50	8
Great Oolite Limestone 19 ft. 2 in.	Rock	14	2	64	10
	Clay	2	0	66	10
	Soft Rock	3	0	69	10
Upper Estuarine	Clay	18	0	87	10
Lincolnshire Limestone.	Rock	27	7	115	5

3. GLINTON FOX COVER.

Water overflows.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil and Fen Deposits.	Soil	2	0	2	0
	Clay and gravel	5	0	7	0
	Clay	4	0	11	0
	Gravel	2	6	13	6
Oxford Clay and Kellaway's Beds.	Clay	4	2	17	8
	Rock	1	6	19	2
	Blue sand	2	6	21	8
	Rock	1	6	23	2
	Hard sand	3	10	27	0
	Dark blue clay	10	2	37	2
Cornbrash.	Rock	7	3	44	5
Great Oolite Clay 12 ft. 8 in.	Clay	10	6	54	11
	Rock	0	4	55	3
	Clay	1	10	57	1
Great Oolite Limestone 11 ft. 9 in.	Rock	1	6	58	7
	Clay	1	0	59	7
	Rock	9	3	68	10
Upper Estuarine.	Clay	26	0	94	10
Lincolnshire Limestone.	Rock	69	10	164	8

Note.—The two borings in the Fox Cover are about 200 yards apart, and together yield 150,000 gallons per day.

4. GLINTON, IN THE FOX COVER.

Water overflows.

Yield (see other boring in the Fox Cover).

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil and Fen Deposits	Soil	3	0	3	0
	Soil and gravel	3	10	6	10
	Gravel	2	2	9	0
Oxford Clay and Kellaway's Beds.	Clay	9	5	18	5
	Stone and clay	6	4	24	9
	Hard grey sand	2	9	27	6
	Sand and clay	1	0	28	6
	Sand	2	8	31	2
	Sand and clay	3	0	34	2
	Clay knobs	7	6	41	8
Cornbrash.	Rock	6	3	47	11
Great Oolite Clay 13 ft. 6 in.	Clay	3	6	51	5
	Clay and sand	5	0	56	5
	Dark clay	5	0	61	5
Great Oolite Limestone.	Rock	11	10	73	3
Upper Estuarine Beds.	Clay and stone	2	3	75	6
	Hard sand	0	6	76	0
	Clay	13	9	89	9
	Green sand	3	9	93	6
	Sand and clay	2	0	95	6
	Clay	2	9	98	3
	Rock	2	11	101	2
	Bind	5	7	106	9
Lincolnshire Limestone.	Rock	72	6	179	3
Lias.	Clay	12	5	191	8
	Rock	1	0	192	8
	Clay	10	6	203	2

Water found at 110 feet 3 in.

Great Creaton.

Water obtained from spring and conveyed in pipes to points of distribution in village.—(Dr. S. M. Copeman, Report to Local Government Board, 1908.)

Great Doddington.

Geol. map 52 N.W. ; One-inch map N.S. 186 ; Six-inch map 39 S.W.

Communicated by Mr. Beeby Thompson.

Great Doddington is supplied with water by numerous and for the most part shallow wells in the Great Oolite Limestone upon which the village stands. A certain amount of water is distributed by gravitation, through pipes, to cisterns at various points, from a service well and cistern situated in a farmyard at the north-easterly end of the village.

If a straight line be drawn from the "Stag's Head" in the north-east to the extreme south westerly end of the village, passing, that is, just north of Upper Street, it practically divides the village into two parts with a water-level differing by about 10 feet, although both water sources are the Great Oolite Limestone. For instance, seven wells on the northern side of the line gave an average water-level of 281 feet above Ordnance Datum, and thirteen wells on the southern side gave an average water-level of 271 feet above Ordnance Datum. Of course individual wells differed somewhat from this. This peculiar distribution, which might be attributed to a fault, appears to admit of a much simpler explanation. The Great Oolite Limestone of the district (*cf.* Wollaston) is divided into two separate masses of rock by a marl bed some 4 or 5 feet thick, which is sufficiently impervious to hold up water.

One well at a farmyard on higher ground, on the outskirts of the village to the north-west, seems to tap a higher source of water, probably from the Cornbrash. The section is about as follows :—

Top about 316 feet above Ordnance Datum.

		Ft.
Boulder clay	Clay with stones - -	11 (?)
Cornbrash ?	Hard rock - - -	4½
Great Oolite Clay (?)	Clay "with yellow stuff like gold" (Iron pyrites)	(?)

To the water, 20 feet 9 inches.

Great Houghton.

Geol. map 52 S.W. ; One-inch map N.S. 185 ; Six-inch map 45 S.E.

Communicated by Mr. Beeby Thompson.

(1) Well to house, south of railway, nearly opposite chapel. (Dr. Paget's.)

Top 282 feet above Ordnance Datum ?

			Ft.
	Uncertain (steined) - - - - - - - -		25
Great Oolite.	Limestone (exposed) - - - - - - - -		7
	Upper Estuarine beds - - -	(probably) -	16
	Lower Estuarine and Ironstone beds of Northampton Sand - - - - - -	(not bottomed) -	24
			72

2. Trial Well in field rather less than ⅓ mile south of the last. Very little water was obtained. Information mostly supplied by Mr. W. Smart, of Denton.

Top about 349 feet above Ordnance Datum.

		Ft.	Ft.
Drift.	Soil and chalky clay - - - - - - -	10	10
Great Oolite Limestone.	Hard white marl - - - - - - - -	8	18
	Limestone, blue and white - - - - - -	15	33
Upper Estuarine	Blue shelly rock—very hard - - - - - -	16	49
Lower Estuarine	Hard sandstone, yellow and white - - - - -	11	60
	Clay - - - - - - - - - - -	2	62
	White and red sandstone - - - - - -	3	65
Northampton Ironstone beds.	Green sandstone (ironstone) - - - - -	12	77
Upper Lias.	Blue clay - - - - - - - - - -	13	90
	Boring in clay - - - - - - - - -	10	100

3. Trial well about half a mile south of the last, on the Preston Deanery Road.

From information supplied by Mr. W. Smart.

Top 354 feet above Ordnance Datum.

	Ft.
Boulder Clay	32
Upper Lias Clay	48
	80

The Upper Lias Clay reached the "Cerithium" beds.

On comparing this section with the last a considerable "fault" between is indicated.

B. T.

Great Weldon.

One-inch map N.S. 171 ; Geol. map 64 ; Six-inch map 17 N.E.

Communicated by Rt. Hon. Earl of Winchilsea and Nottingham.

Boring made by Messrs. E. Timmins and Sons.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Clayey soil with fragments of limestone, etc.	1	6	1	6
Lincolnshire Limestone.	Irregular piped, rubbly decomposed rock	2	0	3	6
	Fissile stone	1	0	4	6
	False-bedded stone with rolled fragments cavernous in places	7	0	11	6
	Rag=Weldon Marble ; dense shelly limestone, blue-hearted, used for walling, road stone, bandings, steps, etc.	3	0	14	6
	Freestone—A. Bed, current-bedded in places	2	6	17	0
	Bottom freestone, A1 Bed	4	0	21	0
	Very fine easily worked stone B, but local	1	6	22	6
	Rough shelly stone—roachy bed—with casts of shells	3	0	25	6
	Fine pink-coloured freestone	4	0	29	6
	Fossil-bed known as Marble Bed (takes a good polish)	2	0	31	6
Northampton Beds.	Ironstone	2	6	34	0
	Sandy clay	0	6	34	6
	Greenish sand passing into Bluish-grey sand	8	0	42	6
	Fossil bed				
Upper Lias.	Blue clay, "Gault"	3	0	45	6

Gretton.

Harborough Hill Farm.

One-inch map N.S. 171 ; Geol. map 64 ; Six-inch map 11 N.E.

Beeby Thompson, *Journ. Northants Nat. Hist. Soc.*, vol. xi., pp. 241-242.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Surface material	4	0	—	
Northampton Beds.	Ironstone	8	0	12	0
	Junction bed. A thin layer of small pebbles or rolled nodules (phosphatic)			—	
Upper Lias.	Clay or Shale, micaceous	15	0	27	0
	Hard whitish stone, Oyster Bed (yielded a little water)	1	3	28	3
	Blue clay	2	6	30	9

Guilsborough.

Geol. map 53 N.E. ; One-inch map N.S. 185 ; Six-inch map 30 S.W.

Communicated by Mr. Beeby Thompson.

The water supply of Guilsborough is from the Northampton Sand.

1. Three wells in the village said to give a very regular yield of water (1895) were respectively :—

40 feet deep with 2 feet of water
45 ,, ,, ,, 1½ ,, ,,
43 ,, ,, ,, ? ,, ,,

According to Mr. Brown, builder, many wells are 50 to 60 feet deep, mostly through rammel and hard rock that does not require bricking up.

In the lower part of the village wells may be only 18 feet deep.

2. GUILSBOROUGH GRANGE LODGE.

Well 45 feet deep, including 10 feet of water.

Hannington.

Geol. map 52 N.W.; One-inch map N.S. 185; Six-inch maps 31 S.E. and 38 N.E.

Communicated by Mr. Beeby Thompson.

Most or all of the wells in Hannington village are comparatively shallow and derive their water from the red Northampton Sand.

1. RECTORY FARM.

(Six-inch map 38 N.E.)

Information as to depth from Mr. Harris, who sank the well.

Well situated near to the farm buildings between the village of Hannington and the Kettering Road. Top about 400 feet above Ordnance Datum.

	Ft.
To the water - - -	40
Water - - - - -	12
Total depth - - - -	52

This was mostly through Boulder Clay, but evidently (judging by material thrown out) went into the Upper Estuarine beds (white sand) of the Northampton Beds.

The water was bad at first, but improved with use.

2. TEA CADDY FARM.

Situation at back of House and Farm buildings about 6⅓ miles from Northampton along the Kettering road. Top about 437 feet above Ordance Datum.

Well - - - - - 100 feet deep.

All Boulder Clay.

Small spring yielding about 400 gallons per day from some chalky gravel at 59 feet down.

Gravelly bed at 99 feet down yields about 1,500 gallons per day, rising 19 feet in the well. (Jan. 1907.)

Hardingstone.

Geol. map 52 S.W.; One-inch map N.S. 185; Six-inch map 45 S.W.

Communicated by Mr. Beeby Thompson.

1. DELAPRE ABBEY.

Top about 211 feet above Ordnance Datum.

Well reported to be 40 feet deep.

There are actually two wells which presumably derive water from the Marlstone or Middle Lias rock-bed, for specimens of *Terebratula punctata* in a green rock, from one well, are in the Northampton Museum. The wells are respectively about 208 feet and 214 feet above Ordnance Datum. They are not much used, as the house is now supplied by gravitation from a spring which issues from the Northampton Sand on the estate.

2. HARDINGSTONE VILLAGE SUPPLY.

Near to village. South of Main Street.

Six-inch maps 45 S.W., 52 N.W.

Communicated by Mr. Beeby Thompson from information supplied by Mr. Abbott in 1898.

Well. Top about 338 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
Great Oolite Limestone.	Soft shelly limestone - 6 ft. to	7	0		
Upper Estuarine Beds.	Dark blue clay - - - -	7	0		
Lower Estuarine and Ironstone Beds.	Purplish ferruginous sands - -	6	0 ?	20	0 ?

Clay not reached—plenty of water.

3. HARDINGSTONE LODGE.

(Rather more than a mile south-east of village.)

A boring was put down near to the house, 30 feet deep, and it yielded a small quantity of water, which stood 17 feet (1900), coming apparently from Drift beds.

A second boring was made to the north of the Lodge, also 30 feet deep, in which the water stood from 17 to 20 feet. Quantity small.

A well was made on the slope still further to the north, near to the 300 feet contour, on the advice of a "Diviner," who promised water at 70 feet. This, according to Mr. W. Smart, was dug 57 feet and bored to 80 feet. No water was found.

The section was ;—

		Ft.
	"Mixed stuff"	10
Upper Lias.	Blue Clay	70
		80

Hardwick.

Geol. map 52 S.W. ; One-inch map N.S. 186 ; Six-inch map 39 N.W.

Communicated by Mr. Beeby Thompson.

Two or three borings and a well were made just to the north of Hardwick, in 1899, by the Wellingborough Urban District Council, and the well yielded a large supply of water, indeed at first the water flowed over the top. There seemed to be no doubt that the water came from the white sands of the Lower Estuarine series, for a spring from the Ironstone beds, only some 50 yards to the north and at a lower level, was unaffected by the pumping, and there was no sign of ironstone in the excavated material. It is an altogether exceptional phenomenon for the white sands to yield water themselves, that is to say, they usually form with the Ironstone beds below one connected porous rock, but the writer could obtain no information beyond what he saw as to the character of the strata passed through at Hardwick.

The large quantity of water, its comparatively high level, and the absence of spring discharge from it, although the water could rise above ground-level, all pointed to a reservoir sealed up in the direction of the dip to the valley, and with little or no connection with the underlying Ironstone beds discharging water into the same valley, close at hand, but at about 15 feet lower level.

At the present time (1908) the original well extends into and below the Ironstone beds, and a large open catchment reservoir goes into but not entirely through the ironstone. Moreover, the ironstone spring referred to above has practically ceased to exist, the water-level having been permanently reduced by pumping, and possibly other causes.

Mr. E. G. Harrison, Engineer and Surveyor to the Wellingborough Urban District Council, has, during the last two or three years, made some trial holes and borings around the site (three are given below), and it would appear from these that an impervious blue clay does occur between the white sands and the ironstone, and now water rises (though not very high) from the ironstone below to the sands above when the clay is cut through. Nevertheless, on this slope the conditions are so variable, owing to slipping, that any apparently necessary theoretical stipulation can be made, such as a clay dam to hold back the water. For instance, the white sand may be 7 feet thick or entirely absent; the ironstone varies from 2 feet to 5½ feet, which latter cannot be considered as its full development in the district, and blue clay (Upper Lias ?) has been found coming nearly to the surface.

Sections and of Borings at HARDWICK.

Communicated by Mr. E. Y. Harrison.

No. 1. Top about 317 feet above Ordnance Datum.

This is the one nearest to the original well and present reservoir.

			Ft.
		Black, peaty soil	1
Upper Estuarine.		Greenish clay with ruddy vertical streaks and a red layer at the base	2
Northampton Beds.	Lower Estuarine.	White sand with vertical black streaks	7
		Dark-coloured clay	3
	Ironstone Beds	Red stones	2
Upper Lias		Blue clay	3
			18

No. 2. Top about 316 feet above Ordnance Datum.

		Ft.
	Soil	1½
Upper Estuarine ?	Blue clay	8
Lower Estuarine.	Sand	2
Ironstone Beds.	Rock	5½
Upper Lias.	Brown clay	2½
	Blue clay	3
		22½

No. 3. Top about 317 feet above Ordnance Datum.

		Ft.
	Soil	3
Upper Estuarine ?	Clay	5
Ironstone Beds.	Stones	1
	Rock	4½
Upper Lias.	Blue clay	4½
		18

At the present time the yield of water varies from 6,000 to 13,000 gallons per hour, and is much affected by rainfall. The water is pumped to Bushfields to be softened and filtered, before delivery into the service reservoirs (see Wellingborough).

Harpole.

Geol. map 53 S.E. ; One-inch map N.S. 185 ; Six-inch map 44 N.E.

Communicated by Mr. Beeby Thompson.

Wells in HARPOLE derive their water supply from the Middle Lias, but only those in the extreme northern end of the village from the rock-bed apparently.

1. Well in the northern part of the village, last house on the NOBOTTLE ROAD.

Top about 302 feet above Ordnance Datum.

	Ft.	in.
To water	3	0
Water	6	0
	9	0

This appears to be the Middle Lias rock-bed source. A spring in a field near, to the east, is about 292 feet above Ordnance Datum.

2. New well in the village, north-east of the CHURCH. 1904.

Top about 281 feet above Ordnance Datum.

Water comes from a grey micaceous sandstone at a depth of 15 feet, and rises nearly to the top of the well.

Some wells are reported to be 30 feet deep.

3. Norwood House in SANDY LANE, half a mile east of Harpole village.

Just west of the house is an old limestone quarry, and there used to be a spring of water from the stone, now carried away by means of drain pipes.

A well made between the above-named quarry and the house, immediately west of the house, in order to tap the spring, failed to do so. According to Mr. Garner, the owner, it passed through 3 feet of limestone rock into clay below for 20 to 25 feet.

Although a " fault " crosses just about here (see succeeding wells) it is difficult to interpret the above description ; it may be necessary to assume slipping as well as a fault.

4. A second well just north of the last, still on the west side of the house, starting at a higher level, went 70 feet in clay (Upper Lias) and of course no water was found.

5. A third well, in the plantation to the north, some 50 feet from the second, starting at about 3 feet higher level, gave plenty of water at 9 feet from the Northampton Sand.

Top of Well about 339 feet above Ordnance Datum.

		Ft.	in.
Northampton Sand.	Ironstone	9	0
Upper Lias.	Clay	3	0
		12	0

Hartwell.

One-inch map N.S. 202; Geol. map 52 S.W.; Six-inch map 52 S.E.

RANGERS' LODGE, SALCEY FOREST.

Aqueous Works and Diamond Rock Boring Company. 1894.

Communicated by Messrs. Clutton. No Water.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Made up ground	7	0	7	0
Boulder Clay.	Blue clay	1	0	8	0
	Blue clay with stones	8	6	16	6
	Clay and gravel	1	6	18	0
	Blue clay with stones	21	0	39	0
Great Oolite Limestone.	Blue clay with thick beds of stone	8	0	47	0
	Hard beds of shells with clay	6	0	53	0
	Hard grey stone and white [flints ?][1] thin beds of clay	4	0	57	0
	Hard grey stone and white [flints?][1]	2	0	59	0
	Mixed rock and limestone	1	6	60	6
	Hard greystone with a bed of clay	3	0	63	6
	Sandstone and beds of clay	2	6	66	0
Upper Estuarine Series.	Blue clay	13	0	79	0
Northampton Sand ?	Hard rock with thin beds of clay	3	0	82	0
Upper Lias.	Blue clay with hard beds of shells	5	0	87	0
	Blue clay	107	0	194	0
Middle and Lower Lias.	Blue clay with beds of dark grey sandstone	7	0	201	0
	Blue clay	3	0	204	0
	Hard rock	2	0	206	0
	Dark grey sandstone	2	6	208	6
	Blue clay	4	0	212	6
	Rock	0	6	213	0
	Blue clay with thin beds of stone	11	0	224	0
	Blue clay	63	0	287	0
	Hard rock	1	0	288	0
	Blue clay	2	6	290	6
	Hard rock	1	0	291	6
	Blue clay	38	6	330	0

H. B. W.

Helpston.

1. WOODCROFT CASTLE.

One-inch map N.S. 158; Geol. map 64; Six-inch map 3 S.W.

Made by Mr. J. E. Noble. 1897.

Communicated by Mr. Henry Preston, F.G.S.

Water overflows; rises 22 feet high.

Yield 16,500 gallons per hour.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift.	Soil	1	0	1	0
	Gravel	4	0	5	0
Great Oolite Clay	Clay	16	0	21	0
Great Oolite Limestone	Rock	12	9	33	9
Upper Estuarine	Clay	35	9	69	6
Lincolnshire Limestone	Rock	3	2	72	8

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[1] The term "flints" is probably applied to fossils.

2. Two-inch Boring at West End of Village.
(Geol. map 64 ; Six-inch map 2 S.E.)
Made by Mr. J. E. Noble.
Communicated by Mr. Henry Preston.
Water level 16 feet below surface.
Yield satisfactory.

		Ft.	in.	Ft.	in.
	Soil	1	0	1	0
Cornbrash.	Stone	2	0	3	0
Great Oolite Clay 18 feet 6 inches.	Clay	15	0	18	0
	Rock	0	6	18	6
	Clay	3	0	21	6
Great Oolite Limestone.	Rock	12	0	33	6
Upper Estuarine 33ft. 6 in.	Clay	23	6	57	0
	Grey marl	10	0	67	0
Lincolnshire Limestone.	Rock	76	2	143	2

Higham Ferrers.

Geol. map 52 N.W. ; One-inch map N.S. 186 ; Six-inch map 40 N.W.
Communicated by Mr. Beeby Thompson.

1. Well and Boring made ¾ mile eastward of the northern end of Higham Ferrers, in a field known as Anchor's Quick (Handcross Quick, according to some) near to the parish boundary, by the Higham Ferrers Council, in 1897.

Water from the limestone stands 70 feet from the top.
Top 270·75 feet above Ordnance Datum.

Well.

		Ft.	in.	Ft.	in.
Glacial.	Clay with much Oxford Clay material	60	6		
	Sand	1	0	61	6
Great Oolite Limestone.	Limestone	12	0		
	Clay	1	8		
	Limestone	2	0	77	2

Boring.

Upper Estuarine to Upper Lias.	Record not very certain, but apparently mostly clay	45	0	122	2

2. Trial well made in a field near to the Chelveston brook known as "Red Link" (Mr. Spong's field), ¾ mile N.W. of Higham Ferrers.

Top 177·81 feet above Ordnance Datum.

			Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
		Soil	1	0	1	0
Great Oolite ? Limestone.		Rubbly limestone ("rammel") white—much coral in it	2	3	3	3
Upper Estuarine.		Purple clay	4	0	7	3
Northampton Sand.	Lower Estuarine 5 ft. 2 in.	White sand	1	10		
		Hard, whitish limestone		6		
		Soft, whitish argillaceous stone	2	4		
		Whitish, sandy clay		6	12	5
	Ironstone Series.	Ironstone, fairly rich, cellular	8	3	20	
Upper Lias.		Blue clay	16	0	36	8

The total depth to the Lias Clay was 21 ft. 6 in. (which is not exactly what the figures above total to) and to the water 18 ft. 6 in.

Higham Ferrers is now supplied with water from a reservoir south-east of Sywell.

Holcot.

Geol. map 52 N.W.; One-inch map N.S. 185; Six-inch map 38 N.E.
Communicated by Mr. Beeby Thompson.

1. Holcot is essentially supplied with water from the Northampton Sand, the wells varying in depth from over 30 feet at the south end, near to the rectory, to mere dip wells in the more northern part of the village, that is to say, down the slope.

2. Trial well in the northern corner of the cross roads where the Holcot to Sywell road crosses the Northampton to Kettering road (1906).

Went down 70 feet, all Boulder clay; no water, *cf.* Hannington—Tea Caddy Farm.

In the southern corner of the same cross roads (actually just in the parish of Sywell) in a small spinney, is an old well, nearly filled up, which used to supply the "Fox and Hounds" Inn, that has since disappeared.

Hollowell.

(Holywell.)

Well for proposed Sanatorium.
Made by Mr. W. Smart.
Geol. map 53 N.E.; One-inch map N.S. 185. Six-inch map 30 S.E.
Communicated by Mr. Beeby Thompson.
Situation about half-a-mile S.W. of Creaton.

			Ft.	in.	Ft.	in.
		Surface material	3	0	3	0
Upper Lias.		Blue clay with fossils and some selenite	35	0	38	0
	Communis beds.	Cephalopoda bed; argillaceous limestone—hard rock about 1 ft. 6 ins. other part shaly—*water*	3	0	41	0
		Hard clay, numerous ammonites	2	0	43	0
	Serpentinus beds	Cephalopoda bed; argillaceous limestone, abundant oolitic concretions in places	2	0	45	0
		Hard clay	0	6	45	6
Middle Lias.		Hard slaty rock, highly micaceous, with large *Protocardium truncatum*	1	0	46	6
		Irregular hard rock joining on to the slaty bed above. A fragmental limestone with lots of little pebbles in it	4	0	50	6
		Fine grained shale—not micaceous, fossiliferous	9	0	59	6
		Hard shelly limestone, ruddy on the whole, much comminuted shell and numerous rolled stones, with much *water*	about	6	60	0

Water rises about 15 feet, and the yield is about 35,000 gallons per day.

No Marlstone rock-bed here.

Horton.

Geol. map 52 S.W.; One-inch map N.S. 202; Six-inch map 52 S.E.
Communicated by Mr. Matthew Holding to Mr. Beeby Thompson.

1. Well at CAVE'S FARM, near to the Railway Station. Sunk 120 feet; the rest bored.

Top, 339 feet above Ordnance Datum.

Water stands 20 feet in the well. 1890.

		Ft.	Ft.
Boulder Clay and Gravel.	Surface soil	2	2
	Yellow clay with chalk and flints	97	99
	Sandy deposit. Fine shells and fossils. Small spring of water	3	102
Upper Lias.	Clay	18	120
	Clay	40	160
	? Rock.		

2. HORTON HALL.

Well supplying the Hall said to be 40 feet deep. Situated about 17 feet lower than Mr. Cave's well ; 322 feet above Ordnance Datum.

Depth of water, 2 feet 2 inches. 1890.

Yield about 8,000 gallons per day, from the Great Oolite limestone.

Irchester.

Geol. map 52 N.W. ; One-inch map N.S. 186 ; Six-inch map 39 S.E.

Communicated by Mr. Beeby Thompson.

Numerous wells exist at Irchester, the majority of them drawing water from the Great Oolite limestone, though at very different levels, owing to one or probably two "faults" cutting the village.

The lower portion of the Great Oolite limestone hereabouts is ferruginous, and is often called ironstone, and confused with the Northampton Sand ironstone.

A selection of the wells about which information seems to be reliable is given below.

1. Well at southern end. 252 feet above Ordnance Datum.

		Ft.
Great Oolite Clay.	Soil, and clay with ironstone nodules	14 ?
Great Oolite Limestone.	Yellowish and irony stone	14 ?
		28

2. Well at southern end. About 252 feet above Ordnance Datum.

		Ft.	in.
Great Oolite Clay.	Soil, and blue clay with ironstone nodules	15	0
	Red rock with a litle *water*	0	7
Great Oolite Limestone ?	Blue clay (? blue rock) with oysters	13	0
		28	7

3. Well at southern end near the branch road to Wollaston, E. side of Street. About 240 feet above Ordnance Datum.

		Ft.
Great Oolite Limestone and Upper Estuarine ?	Limestone rammel	19
	Blue shelly clay	
Northampton Sand.	Limestone (?) (*water*)	8
	Ironstone	6
Upper Lias.	Clay	7
		40

4. Wells to new houses on the Wollaston road show great variation in depth and water-level, owing to one of the faults referred to ; they evidently all derive water from the Great Oolite limestone. No good section can be quoted.

5. Wells down the main street of the village mostly derive water from the Great Oolite limestone at variable depths according to situation of the well.

Wells at the northern end of Irchester tap the Northampton sand.

6. CATTEL OR CATTLE LANE WELL—Town pump. 210 feet above Ordnance Datum.

From information by Mr. Berrill, builder, who recently reconstructed it.

		Ft.	in.
	Top soil	1	6
	Yellow clay	1	6
	Stone and clay	1	6
	Clay and Limestone mixed, small	3	6
	Yellow clay	1	6
	Blue clay	1	6
Ironstone Beds	Red ironstone, small bits	5	6
	Strong ironstone rock	4	0
Upper Lias	Blue clay	3	3
		23	9

Water stands 4 feet 3 inches in the well.

7. IRCHESTER GRANGE.

Communicated by Mr. Beeby Thompson.

Well. Top, about 273 feet above Ordnance Datum.

	Ft.
To water	57½
Water	4
Total depth	61½

Water from Great Oolite limestone apparently.

Communicated by Mr. A. C. G. Cameron.

8. Well. Water level 20 feet down. May, 1898.

		Thickness. Ft.	in.	Depth. Ft.	in.
	Soil	2	6	2	6
[Great Oolite Series.]	Shelly Limestone (with Ostrea bed)	10	0	12	6
Northampton Beds.]	Ironstone	9	0	21	6
	Grey sandy marl, with black pebbles, large and small, and irregular shaped lumps	2	6	24	0
Upper Lias	Blue clay	6	0	30	0

9. 250 yards S.W. of Parish CHURCH.

Sunk 23½ feet, the rest bored.

No water—abandoned.

		Ft.	in.	Ft.	in.
	Shelly Oolite debris	1	6	1	6
[Northampton Beds and Upper Lias.]	Blue clay with a course or two ferruginous rock	22	0	23	6
	Blue clay	10	0	33	6

10. 300 yards west of METHODIST CHAPEL.

Water stands 12 feet in well.

	Ft.	in.	Ft.	in.
Clay and stone	18	0	18	0
Blue rock and clay	4	0	22	0
Solid clay	4	0	26	0

11. LITTLE IRCHESTER.

Sunk with heading on top of clay.

		Ft.	in.	Ft.	in.
[Northampton Beds.]	Ironstone rock	15	0	15	0
[Upper Lias.]	Clay	15	0	30	0

12. IRCHESTER LODGE.

Well through Great Oolite, etc., to Depth of - 70 0

13. Borehole about 700 yards S.S.E. of IRCHESTER LODGE. Carried through 50 feet of clay [? also overlying beds] to hard rock.

Irthlingborough.

Geol. map 52 N.W.; One-inch map N.S. 186; Six-inch map 40 N.W.

1. Old Well, 1903. Communicated by the Local Government Board.

270 feet above Ordnance Datum.

Yield 90,000 gallons per day, in Well.

	Thickness. Ft.	Depth. Ft.
Top soil and ironstone [? refuse]	10	10
Boulder clay, gravel Great Oolite clay	30	40
Great Oolite limestone	20	60
Northampton Sands	17	77
Blue Lias Clay	1	78

This record does not agree with that of the New Well. Possibly the absence of the Upper Estuarine beds is due to faulting.

H. B. W.

2. New well, S.W. of village, 1907. Communicated to Mr. Beeby Thompson by Mr. W. Smart.

About 247 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
	Soil	1	0	—	
Cornbrash.	Limestone	2	0	3	0
Great Oolite Clay 11 ft. 6 in.	Clay	11	6	14	6
Great Oolite Limestone 25 ft 6 in.	Limestone	0	6	—	
	Clay	1	6	16	6
	Limestone	23	6	40	0
Upper Estuarine Beds 17 feet.	Clay and Marl	3	0	—	
	Blue clay	2	0	—	
	Yellow clay	1	6	46	6
	Blue rock (Estuarine limestone), coated with iron	5	6	—	
	Blue clay	2	0	—	
	Red rubble and clay	3	0	57	0
Northampton Beds 30 feet.	Ironstone and white sand mixed	1	6	—	
	Ironstone	2	6	—	
	Dark blue rock and iron	5	0	—	
	Red sandstone	4	0	—	
	Blue rock coated with iron	12	6	—	
	Clay	1	6	—	
	Blue rock	3	0	87	0
Upper Lias.	Clay	10	0	97	0

Yield of Water at test pumping, 12,000 gallons per hour; rises 22 feet.

At the present time, July 1908, the combined yield of the two wells is only 17,000 gallons per day, and it is now proposed to sink to the Marlstone.

B. T.

Isham.

One-inch map N.S. 186; Geol. map 52 N.W.; Six-inch map 32 S.W.

Communicated by Mr. Beeby Thompson.

Trial well near the Orlingbury road, about 1 mile westward of Isham.

Height above Ordnance Datum 272 feet.

Water Level 267 feet above Ordnance Datum.

Yield 24,040 gallons per day.

			Ft. Thickness.	in.	Ft. Depth.	in.
		Soil	1	0		
Upper Estuarine Beds.		Rammel—white rock	3	0		
	Estuarine Limestone.	Limestone with some *water*	2	6		
		Dark blue clay	11	6	18	0
Lower Estuarine Beds and Ironstone series.		White sand and clay	6	0		
		Blue rock with *water*	1	0	25	0
		Running sand	0	6		
		Ironstone	4	6	30	0
Upper Lias.		Blue clay	5	0	35	0

Actual depth 33 ft. 6 in.

Kettering.

One-inch map N.S. 171; Geol. map 52 N.W.; Six-inch map 25 S.W.

1. Town Supply. By Mr. Beeby Thompson.

Kettering was at one time supplied with water by wells in the Northampton sand, and as late as 1900 it was estimated that more than 11,000 persons out of a population 30,000 still used private wells.

A water company was formed some years back, and the works and rights of this company were acquired by the Urban District Council by the Kettering Water Act of 1898.

On the promotion of a Bill in Parliament, "The Kettering Urban District Water Act, 1901," for additional works of water supply, the resources were then variously estimated at :—

	Gallons per day.	Gallons per day.
Cransley Reservoir	550,000	550,000
Weekley Well	100,000	85,000
Clover Hill Well	25,000	40,000
	675,000	675,000

The Cransley Reservoir made by the Kettering Waterworks Co., Ltd., under an Act of 1889 is situated in the valley between Cransley and Thorpe Malsor; it is supplied by permanent springs from the Northampton sand, and by a drainage area of about 1,805 acres. When full it occupies about 52 acres, is 30 feet deep at the lower end, has a capacity of 160 millions of gallons, and a top water level of 298·5 feet above Ordnance Datum (Mansergh).

At the present time (1908) another reservoir is in course of construction in the valley between Thorpe Malsor and Orton, to be known as Malsor reservoir, this will also be fed by permanent Northampton Sand springs and the drainage from about 2 square miles, and according to Mr. Mansergh, when full, it will cover 34 acres, be 45 feet deep at the lower end, and hold 140 millions of gallons.

The Clover Hill supply is from the Northampton sand, as is also the Weekley one. (*See* Weekley.)

For the storage and distribution of the pumped water there are three covered service reservoirs as follows :—

Warren Hill (to the W. of Kettering), 300,000 gallons. Top water level 341 feet above Ordnance Datum.

Clover Hill (to the N. of Kettering), one of 300,000 gallons and one of 200,000 gallons. Top water level 339 feet above Ordnance Datum.

Also at the same place a Tower with tank holding 42,300 gallons. Top water level 365 feet above Ordnance Datum.

2. Clover Hill Well. Constructed 1886-7.

Communicated to Mr. Beeby Thompson by Mr. Thos. Hennell.

Top, 335 feet above Ordnance Datum.

		Ft.
Upper and Lower Estuarine Beds.	Loose rock or "hassock"	6
	Clay	5
	(*no record*)	29
Ironstone Series.	Hard rock (not requiring lining)	24
Upper Lias.	Clay	4
		68

Two headings were driven in the rock on top of the clay of 70 feet and 20 feet respectively.

The quantity of water at first was very large, but it was drawn off to a considerable extent whilst the work was in progress and never replaced. The minimum yield in 1898 was estimated at 90,000 gallons per day, but it has fallen off a good deal since then.

3. The Brewery (Mr. Elworthy).

Made and communicated by Messrs. Isler & Co., to Mr. Whitaker.

Dug 5 feet, the rest a boring of 6 inches diameter.

Water-level 53 feet down. Supply 600 gallons an hour.

		Thickness. Ft.	Depth. Ft.
	Made ground and clay	8	8
	Mixed clay	10	18
Northampton Beds.	Dead sand	2	20
	Sandstone	10	30
	Dead sand	8½	38½
	Sandstone	7	45½
	Blue rock	½	46
	Grey rock	2	48
	Rock	3¼	51¼
	Blue rock	1¼	52½
	Sandstone	4	56½
Upper Lias.	Blue marl	13½	70

4. KETTERING FURNACES.

Beeby Thompson, *Journ. Northampton. Nat. Hist. Soc.*, Vol. i., p. 299.

Well. 1878.

Top, about 295 feet above Ordnance Datum.

	Ft.	Ft.
Ferruginous beds of Northampton Sand - -	13	13
Upper Lias - - - - - - - - -	163	176
Middle Lias - - - - - - - - -	8	184

The above is a corrected section based upon Mr. Sharp's statement (*Journ Northampton. Nat. Hist. Soc.*Vol. i., p. 292) that the Upper Lias was 176 feet thick (obviously including the Ferruginous beds which consist of slipped material), and the definite statement made by Mr. Herbert Sartoris in 1889, that the Marlstone bed was encountered at 119 feet above Ordnance Datum.

A boring was carried down a few feet lower than the well, but comparatively little water was found, and it did not rise much above the rock from which it came. The bore-hole was plugged and the well itself merely used as reservoir for storing brook water which is admitted by an adit.

BORING FOR COAL.

In the *Northampton Mercury* of Feb. 24th, 1766, occurs the statement that the inhabitants of Kettering "who have been for some time boring for coal, with great prospect of success, are now in daily expectation of coming at that much-wanted necessity of life, as they have already bored to the depth of 150 yards, and have the same tokens as are found in the coal countries."

Kingsthorpe.

One-inch map 185 ; Geol. map 52 N.W. ; Six-inch map 45 N.W.

1. BORING FOR COAL.[1]

Sharp, Samuel, "Note on a Futile Search for Coal near Northampton." *Geol. Mag.*, vol. viii., p. 506.

Sharp, Samuel, "The Oolites of Northamptonshire." Pt. I., *Quart. Journ. Geol. Soc.*, xxvi. 1870, p. 364.

Thompson, Beeby, "Middle Lias of Northamptonshire." *Midland Naturalist*, vol. x., p. 56.

Thompson, Beeby, "The Use of a Geological Datum." *Geol. Mag.*, Decade iv., vol. x., p. 216.

The Kingsthorpe Shaft was made in 1836 by a company styled "The Northampton Union Coal and Mining Company." After the expenditure of £30,000 without either finding coal or proving its absence the works were abandoned.

The section of this shaft according to a diagram, with pencil notes supposed to have been made by Dr. William Smith, formerly in the possession of the late Mr. S. Sharp, is as below :—

Kingsthorpe Shaft, some 2½ miles N.E. of the centre of Northampton.

	Thickness. Ft.	Depth. Ft.
Rocks down to the base of the Marlstone - -	210	210
Middle and Lower Lias - - - - - -	650	860
(Undescribed) - - - - - - - -	20	880
Sandstone - - - - - - - - -	60	
Red marl - - - - - - - - -	12	
Conglomerate - - - - - - - -	15	967

Mr. Sharp himself doubted the accuracy of the description, and more recent wells and borings in the neighbourhood made it impossible to accept the thicknesses of the Oolitic and Liassic beds as correct. In one of the papers quoted above the writer pointed that by reading 270 instead of 210 for the base of the rock yielding water everything fitted admirably. Then, at a depth of 270 feet "a water yielding limestone rock" gave 36,000 gallons per hour. As confirmatory of this, when the well was opened up for testing the water and water yield, in 1881, the water-level was exactly 270 feet from the surface ; that is, there was 697 feet of salt water in the shaft (*J. N. Nat. Hist. Soc.*, Vol. i., p. 223. 1881).

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[1] Further references to the Kingsthorpe boring are given in the Geological Survey Memoir on "The Jurassic Rocks of England," vol. iv., p. 493 ; *see also* Brown, "The Iron Ores of Northamptonshire," *Trans. S. Wales Inst. Eng.*, vol. ii., 1861, p. 197 ; and *Mining Journal*, Sept. 3, 1854.

Mr. Sharp, in one place (*J. N. Nat. Hist. Soc.*, Vol. i., p. 291) says that the water rose to within 60 feet of the surface. This is obviously a mistake for various reasons, but in the revised section below it will be seen that this must refer to the Northampton Sand water and not the Marlstone water.

Finally, there happens to be in existence a specimen of the undescribed rock, labelled by Miss Baker, "Top of Red Sandstone upwards of 900 feet, Kingsthorpe Shaft," and it is a conglomerate (also compare with Spinney Well, Kettering Road, Section, p. 135.)

The revised section below may not be perfectly accurate, but it is as near as is at present possible to give it; the thicknesses of the Oolitic beds given in brackets are derived from a well (*see* Moulton Park) rather more than one mile away to the east.

KINGSTHORPE SHAFT.

Revised Section by Beeby Thompson.

Top. 374 feet above Ordnance Datum.

		Ft.	Ft.
[Great Oolite.]	Soil and remnants of Great Oolite limestone Upper Estuarine Beds (29 ft 8 in.)	34 ?	34
[Northampton Sand, 49 feet:]	Lower Estuarine beds (26 ft. 2 in.) Ironstone beds (22 ft. 6 in.) reported to be 35 feet thick.	49 ?	83
[Lias 777.]	Upper Lias	183 ?	266
	Middle Lias	100 ?	366
	Lower Lias, with stone beds towards the base	494 ?	860
[Rhætic.]	Conglomerate, chiefly of limestone pebbles in a greenish sandy matrix	20	880
[Trias.]	Sandstone	60	
	Red Marl	12	
	Conglomerate	15	967

No water whatever comes from the Marlstone now, so far as can be judged, on account of exhaustive pumping from the same bed for many years at Northampton. The salt-water level is 104 feet above Ordnance Datum, or 270 feet from the surface, and the possible yield is supposed to be from 100,000 to 200,000 gallons per day. B. T.

(Six-inch map 38 S.W.)

2. Well at WHITE HILL Sand Pits, about ¾ mile North of Kingsthorpe, (Boughton turn), Mr. Cosford's Pits, 1898.

Communicated by Mr. Beeby Thompson.

			Ft.	in.	Ft.	in.
		Open Working.				
Northampton Sand.	[Lower Estuarine.]	White and ruddy sand, with some argillaceous layers	11	0	11	0
		Well.				
		Yellowish sandy clay	3	0	14	0
		Black layer	0	6	14	6
		Hard, grey or purplish, sandy clay, with red sandy layers in it, numerous plant markings	7	6	22	0
		Yellowish sand or sandstone with numerous vertical plant markings	4	0	26	0
	[Iron-stone beds.]	Red sandy layers—much iron, no plant markings noticed Hard blue ironstone rock Soft red sandstone	19	0 ?	45	0

Water stands about 7 feet in the well.

Kislingbury.

Geol. map 53 S.E.; One-inch map N.S. 185; Six-inch map 44 S.E.

Communicated by Mr. Beeby Thompson.

Until recent years Kislingbury was supplied with water by means of wells which varied so much in depth that obviously different sources of water were utilized. In the northern part of the village, towards the river, the wells are shallow and derive their water from the Valley gravel; in the southern part there are a few wells, from 40 to 50 feet deep, which derive their water from one of the hard beds in the Middle Lias. There is now a public water-supply derived from a Northampton Sand Spring known as "Garner's Spring," upwards of a mile away to the north-west, in the parish of Upton.

Litchborough.

Geol. map 53 S.E. ; One-inch map N.S. 202 ; Six-inch map 50 S.E.

Communicated by Mr. J. B. Williams to Mr. B. Thompson.

Boring, near to a Spring, about ⅓ mile W. of the Village. (1899 about.)

		Ft.	Ft.
	Soil	2	2
[Drift] ?	Yellow clay	8	10
	Blue clay	15	
	Yellow clay	2	27
Northampton. Sand ?	Sand and stone	17	
	Hard brown rock	2	
	Sand and Stone	6	52
Upper Lias ?	Blue Clay	9	61

Water was found at 11 feet, and lost again at 42 feet. No use was made of the boring.

Long Buckby.

Geol. map 53 N.E. ; One-inch map N.S. 185 ; Six-inch map 36 N.E.

From Dr. R. Bruce Low's Report to the Local Government Board on the Water Supply of Long Buckby. 1896.

There were, in 1896, at Long Buckby, 116 wells, some six of which were public wells. The depth of the wells varied according to their position on the slope. Including the surface springs nine were under 10 feet in depth ; twenty-eight from 10 to 20 feet ; forty-one from 20 to 40 feet ; ten were over 40 feet deep. Of the remaining twenty-eight no accurate depths could be ascertained.

Two wells were stated to be 85 feet deep.

At the Eastern end of the village superficial gravel beds supply the water, towards the middle of the village similar gravel beds resting on Upper Lias Clay and covered by variable amounts of Boulder Clay. At the western end wells derive their water from the Middle Lias.

1. Boring at Long Buckby.

(Six-inch map 37 N.W.)

Communicated by Mr. Beeby Thompson from information supplied by Mr. Taylor, Clerk of the Works.

As a preliminary to a public water supply a boring was made on the high ground to the E. of Long Buckby just in the angle between the two roads leading to Northampton and West Haddon respectively, and below is the section recorded :—

	Ft.	in.	Ft.	in.
1. Loamy sand and flints	9	0	9	0
2. Sandstone	21	0	30	0
3. Sandy clay	19	0	49	0
4. Blue clay	185	0	234	0
5. Rock	9	0	243	0
6. Blue clay	5	6	248	6
7. Rock with water	18	6	267	0
8. Blue clay	2	0	269	0
9. Grey rock	12	6	281	6
10. Blue clay	6	6	288	0
Below this alternating clay and rock to			332	6

Water stood 236 feet from the surface (*see* below).

2. Well at Long Buckby.

Same situation as the boring.

Communicated by Mr. Beeby Thompson from information derived from several sources, particularly Mr. Henry Martin's foreman, and personal observations of the material.

Top, 580 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
Drift and Northampton Sand.	1. Soil with flints and sand	9	0	9	0
Northampton Sand.	2. Sandstone	21	0	30	0
	3. Sand	20	0	50	0
Upper Lias.	4. Blue clay	162	0	212	0
	5. Clay with stones	21	0	233	0
	6. Hard bed with abundant ammonites	1	0	234	0
	7. Fish-bed, exceedingly hard, crystalline and pyritous	0	3	234	3

2. WELL AT LONG BUCKBY.—*continued.*

		Ft.	in.	Ft.	in.
Middle Lias.	8. Rock-bed. A calcareous rock with exceedingly numerous small pebbles, giving to the rock an oolitic appearance, and a smaller number of rather larger rounded calcareous stones - - -	1	6?	235	9
	9. A homogeneous, hard, argillaceous limestone—rather unfossiliferous	5	3?	241	0
	10. Exceedingly fossiliferous layer, practically all *Protocardium truncatum* - - - - -	1	0	242	0
	11. Clay and "Soft shelly stuff"	9	0	251	0
	12. Hard rock yielding abundance of *water* at 251 feet. Not pierced	2	0?	253	0

Beds 6 to 10 inclusive formed one hard rock 9 feet thick, corresponding with 5 of the boring.

It is the general impression that the marlstone water was tapped in this well, but that is quite a mistake as the section above will show. The 9 feet bed of the boring (6 to 10 of the well) was described as "bone dry," and from it came the "foul air" which killed three of the workmen in 1905; it "hissed out" as though under considerable pressure. Later on, on one occasion, the foreman heard a hissing as before, and tried to find the place with a candle, but the flame was sucked in instead of being blown away. Also the same set of beds took water instead of yielding it, and evidently determined the height to which the water could rise in the boring. The yield of water at the finish was estimated at about 168,000 gallons per day, and it stood 5 feet to 6 feet in the well on resting.

B. T.

3. BUCKBY FOLLY.

Well to the east of the above boring and well.
Said to be 60 feet deep.

4. Well at BUCKBY TOLL HOUSE.

Grand Junction Canal.
(Six-inch map 36 S.E.)
Communicated by Mr. Beeby Thompson from information supplied by Mr. F. W. Millner.

		Ft.	in.	Ft.	in.
Drift.	Soil - - - - - - - - - - - - -	1	6	1	6
	Marl and brown clay - - - - - - - -	10	6	12	0
	Blue clay and chalk stones - - - - -	9	0	21	0
	Loamy sand (*water*) - - - - - - - -	5	6	26	6
	Blue clay with chalk and flint - - - - -	3	6	30	0

Water rose to within 4 feet 6 inches of the top.

Marholm.

1. Twelve-inch Boring at MARHOLM CROSSING for Midland Railway Company.

4½ miles N.W. of Peterborough.
One-inch map N.S. 158; Geol. map 64; Six-inch map 3 S.W.
Made by Mr. J. E. Noble, Thurlby, near Bourne, 1900.
About 30 feet above Ordnance Datum.
Communicated by Mr. Henry Preston, F.G.S.
Very good yield of water.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil - - - - - - - -	2	0	2	0
Drift and Kellaway's Rock.	Clay and stone - - - - -	7	5	9	5
	Rock - - - - - - - -	4	10	14	3
	Clay and stone - - - - -	6	9	21	0
	Clay - - - - - - - -	1	6	22	6
Cornbrash - - -	Rock - - - - - - - -	6	4	28	10
Great Oolite Clay - -	Clay - - - - - - - -	13	8	42	6
Great Oolite Limestone -	Rock - - - - - - - -	11	5	53	11
Upper Estuarine - -	Clay - - - - - - - -	22	6	76	5
Lincolnshire Limestone.	Bind - - - - - - - -	4	0	80	5
	Grey sand - - - - - -	7	0	87	5
	Rock - - - - - - - -	64	6	151	11

This boring is 40 feet from the 8-inch boring.

2. Eight-inch Boring at MARHOLM CROSSING for Midland Railway Company.

Made by Mr. Noble and communicated by Mr. Preston.

Water supply good.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	2	0	2	0
Drift and Kellaway's Rock.	Gravel	2	0	4	0
	Clay and sand	5	0	9	0
	Rock	4	6	13	6
	Clay	8	6	22	0
Cornbrash	Rock	6	4	28	4
Great Oolite Clay.	Clay	14	3	42	7
Great Oolite Limestone.	Rock	11	1	53	8
	Clay	3	4	57	0
	Rock	1	0	58	0
Upper Estuarine.	Clay	20	0	78	0
Lincolnshire Limestone.	Rock	76	10	154	10
Upper Lias.	Clay	9	0	163	10

Milton.

1. THE GREYHOUND INN.

One-inch map 202 ; Geol. map 53 S.E. ; Six-inch map 51 N.E.

About 280 feet above Ordnance Datum.

Beeby Thompson, *Midland Naturalist*, Vol. ix., pp. 74–76, Vol. x., p. 177.

		Ft.	in.
Upper Lias.	Soil and clay	3	0
	Light blue clay numerous ammonites	6	0
	Yellowish or red sandy clay with a few nodules 1 ft. to	1	6
	Dark blue clay, scarcely any fossils	4	6
	Paper-shale, 6 in. Fish bed, 6 in. Paper-shale 6 in.	1	6
Middle Lias.	Hard stone, black in fissures, blue hearted, pebbles and concretions rather plentiful. About 2 ft. Very ferruginous bed, highly fossiliferous, about 1 ft. Light coloured and soft rock, quite oolitic in places About 1 ft.	4	0
	Dark blue micaceous clay getting more sandy towards the bottom A band of highly fossiliferous nodules about 1 ft. from top. Hard bed, seems to be made up of highly fossiliferous nodules	10	0
		30	6

The water rose from the bottom bed and stood in the well 10 ft.—it shows no tendency to sink lower and by their present pumping power (900 gallons per hour) they can reduce the water-level only 4 feet. Thus it will be seen that a difference of head of 4 feet between water level in well and adjacent strata, gives a flow of about 21,600 gallons per day.

2. MILTON RECTORY.

Communicated to Mr. Beeby Thompson by Mr. W. Smart.

		Ft.
	Soil	1½
Glacial Drift	Sandy loam	3
	Sand	15½
		20

Water rises 7 feet : quantity 300 gallons per hour.

3. MANOR HOUSE FARM.

Communicated by Mr. Beeby Thompson.

Opening near to railway.

Top about 288 feet above Ordnance Datum.

		Ft.
Boulder Clay	Soil and yellowish clay with stones	4
	Dirty blue clay with chalk stones	4
Glacial Sand	Sand	37¼
		45¼

Water stopped further sinking.

Moulton.

Geol. map 52 N.W.; One-inch map N.S. 185; Six-inch map 38 S.W.

MOULTON PARK FARM (ST. ANDREW'S HOSPITAL FARM).

Communicated by Mr. Beeby Thompson, from information supplied by Mr. Dorman (architect), and Mr. Cosford (contractor), and personal observation.

1. Stable Yard Well.

			Ft.	in.	Ft.	in.
Boulder Clay.		Clay with boulders and erratics	17	0	17	0
Great Oolite Limestone.		Hard limestone rock	6	0	23	0
Upper Estuarine 29 ft. 8 in.		Sandy clay with numerous green plant markings	10	0	33	0
	Estuarine limestone.	Fossiliferous limestone with *water*	6	0	39	0
		Blue clay with many fossils	13	8	52	8
Lower Estuarine 26 ft. 2 in.		Sandstone Purple clay full of plant remains Black clay very full of vegetable matter Red rock—ferruginous limestone Whitish sand—vertical plant remains Hard blue limestone White or purplish sand, with vertical plant markings Reddish sandstone	26	2	78	10
Northampton Ironstone series.		Hard rock	3	8	82	6

A boring was made from the bottom of the well 50 feet, about, but no more water found.

2. Orchard Well.

Another well near to the last-described is 27 feet deep and derives water from the Great Oolite limestone. The section being, no doubt, about as below :—

		Ft.	in.
Boulder clay	Clay	17	2
Great Oolite	Limestone	6	0
Upper Estuarine	Clay	3	10
		27	0

3. Milkman's Cottage Well.

One third of mile to N.N.E. of last two.

Probable Section.	Ft.	in.
Soil or Boulder clay	1	10
Upper Estuarine beds	29	8
Lower Estuarine beds	26	2
Ironstone beds	22	4
Total depth	80	0

The ironstone rock is not bricked over.

4. Well made in a field about ¼ mile to the S.S.E. of the Farm.

			Ft.	in.	Ft.	in.
Drift.		Clay—very white and chalky	4	6		
		Limestone gravel with *water*	1	0	5	6
Upper Estuarine.		Green clay with vertical plant markings	5	6		
		White or greenish marl, very hard, with vertical plant markings	3	0		
		Blue clay with some highly fossiliferous layers	5	2		
		Blue shale, hard, numerous fossils	0	2		
		Clay exceedingly fossiliferous	0	4		
	Estuarine limestone.	Blue argillaceous limestone, numerous fossils	2	5		
		Hard crystalline limestone with *water*	2	1	24	2

Newborough.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 3 S.E.

Made by Mr. J. E. Noble, Thurlby, near Bourne, 1898.

Communicated by Mr. Henry Preston. F.G.S.

Very good supply.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Fen deposits, Oxford Clay and Kellaways Beds.	Clay	77	6	77	6
	Sandstone	10	3	87	9
	Clay	6	7	94	4
Cornbrash	Rock	9	1	103	5
Great Oolite Clay	Clay	9	8	113	1
Great Oolite Limestone	Rock	8	10	121	11
Upper Estuarine Beds.	Clay	3	4	125	3
	Rock	1	0	126	3
	Clay	19	10	146	1
Lincolnshire Limestone	Rock	37	10	183	11

Newbottle.

On site of storage tank.

4 miles west of Brackley.

One-inch map N.S. 218 ; Geol. map 45 N.E. ; Six-inch map 62 N.E.

Communicated by Local Government Board. Date 1891.

Water level 12 feet below surface.

Yield—on reaching the sand water rose 18 feet in the well and stood at that level although continually pumped, but so much difficulty was met with owing to the loose sand choking the suction pipe that another source had to be obtained.

		Thickness	
		Ft.	in.
	Top soil	2	0
Great Oolite Series.	Shale (limestone)	2	3
Estuarine Beds	Marl (blue clay and limestone)	25	0
Northampton Sand.	White running sand	0	9
		30	0

Northampton.

One-inch map N.S. 185; Geol. maps 52 S.W., S.E.; Six-inch maps 44 N.E., S.E., 45 N.W., S.W.

By Beeby Thompson, F.G.S., F.C.S.

Old Northampton stands in an angle formed by the two main branches of the river Nene. The westerly or Staverton branch of the Nene in its easterly course to the sea intercepts the northerly or Naseby branch in its southward course, at Northampton, and the incorporated streams, after forming the southern boundary of the old borough for two miles or more, take a general north-easterly direction to the sea.

It is certain that a fault traverses the southern part of Northampton, but whether there is a second fault meeting this near to the junction of the two streams, or the one fault takes a more north-easterly trend about this point, is not quite clear, though with the information available and a little further detailed investigation it could no doubt be made out. Suffice it to say here and now that whereas the Naseby branch of the river did run over comparatively high beds of the Upper Lias nearly or right down to the bend, the united streams did run over the lowest beds of the Upper Lias and the highest beds of the Middle Lias, just previous to the deposition of the river gravels. The downthrow of the fault is on the northern side of the main valley, and the greatest difference of level observed in the Marlstone rock-bed, in wells on opposite sides of it and not far removed from each other, is 105 feet.

Although the fault or faults will largely explain the abnormal dip of the Northampton Sand both to the south and west within Northampton, unquestionably slipping of the Northampton Sand over the Upper Lias Clay towards the valleys, that is in the direction of the fault or faults, has contributed to the results observed on the steeper parts of the slopes, particularly the diminished thickness of the Upper Lias (*cf.* Electric Light Works well.)

The main portion of modern Northampton is on a hill; the rise from the river, or rather from the alluvial flats of the river valley, is rather steep at first, and then becomes more gentle. The official centre of the town, the Market Square, is about 60 feet above the river, but the highest parts of Northampton, between the Kettering and Wellingborough Roads towards Abington, where the service reservoirs are situated, are some 140 feet above the nearest part of the Nene. Yet from nearly the lowest to the highest points Northampton Sand occurs at or fairly near to the surface, consequently Northampton Sand wells can be made almost anywhere within the town.

SPRINGS.

Another noticeable characteristic is that, with the exception of some half mile to the N.E. of the present town, between the Wellingborough and Kettering Roads near to Abington, Northampton is surrounded by valleys carrying streams fed by Northampton Sand springs. Those springs that were within the old town, and others a little without those limits, have contributed largely to the water supply of the inhabitants in diverse ways as will be shown.

By following the springs round the town a good idea is obtained of the abnormal dip of the Northampton Sand. Thus, starting from the western side of the thin neck of land referred to above, we have Northampton Sand springs as follows:—

Springs on Westward Slope.

1. About 283 feet above Ordnance Datum. SWALLBROOK SPRING. Just east of the Kettering Road and of the Kettering Road well and boring (Spinney Well). This, together with others at a greater distance away, was used as a supplementary supply in a time of emergency, just before the construction of the Ravensthorpe reservoir.

In the *Northampton Mercury* of 1724 is an announcement of a bull race (bull, cow, or bullock) to take place on Tuesday of Whitsun-week (May 26th) from the gate of William Thursby, Esq., leading into the Wellingborough Road, down Abington Street to the pump upon the Corn-market Hill, &c. A later announcement said that the bulls, &c., were to start from the bridge near SWALLBROOK SPRING and run down Abington Street to the pump as before arranged.

The identification of Swallbrook Spring seems to have puzzled a few people but apart from the probability that this is the spring meant, since it is the only one that was near to a bridge in the necessary direction from the town, it would appear that the brook it partly supplies was known as SWARWELL BROK or SWARSWELL in the time of Rich. II., (*see* Latin quotation in "Kingsthorpiana, or Researches in a Church Chest" by J. Hulbert Glover, M.A., p. 23.). In the same work, p. 135, is a description of the boundaries of the parish of Kingsthorpe (temp. James I.) from which it seems that the less important though more distant spring rising in Bush Hill Spinney, east of Abington Lodge, was then known as SWARBRICK (?) HEAD.

2. At 250 feet above Ordnance Datum. Race Course Springs.

3. At 246 feet above Ordnance Datum. Kingsley Road (Gipsy Lane) towards the stream.

4. About 232 feet above Ordnance Datum. Springs into brickyard at Half-way House, Kingsthorpe Road.

5. At 219 feet above Ordnance Datum. Just westward of the brickyard towards the river.

6. About 210 feet above Ordnance Datum. Near to the river a little above St. Andrew's Mill. Site now occupied by new road.

7. About 200 feet above Ordnance Datum. Spring into Mr. Martin's brickyard on westerly side of the river, a little S.W. of St. Andrew's Mill. Water actually comes through gravel, but is fed by Northampton Sand.

8. At 207 feet above Ordnance Datum. Spring head in Spring Lane. The old spring which gave its name to the street is situated at the back of both Spring Lane and Monkspond Street. By going along a narrow passage in Spring Lane a yard is discovered which acts as a common back way to a few houses in each of the streets named, and in the lowest part of this yard there is a recessed portion of a wall, and this is where the spring used to issue from the ground. There is no water running now (1908), that can be seen; it has been carried underground by pipes. A portion of the spring is collected by pipes and utilised in Messrs. Pettit's tannery.

This spring probably supplied St. Andrew's Priory with water, and almost certainly fed the pond of the Priory, which pond was situated on the site of the present Monkspond Street.

9. About 205 feet above Ordnance Datum. SCARLET WELL, at the bottom of Scarletwell Street. Scarlet Well is said to have derived its name from the reputation of its water for giving a brilliant scarlet with certain dyes, then in use. There appears to be no doubt on this point, for there are records of cloth having been sent from London and Nottingham (fifteenth century) to be dyed scarlet. Scarletwell Street is mentioned in a British Museum Charter of 1239, so evidently the real or supposed qualities of the water for dyeing were recognised before that date. The brick building which encloses the well (actually a freely-running spring) was erected in 1837 by Mrs. Kerr, the widow of Dr. Kerr, noted for his services to the Northampton Infirmary. The spring was reached by descending a few steps, but the entrance is now bricked up because the water is unfit for domestic use.

Around the bend of the river no definite freely-running springs are known, but probably there were some at one time. Kingswell Street or Lane, a very old name for a one-time important thoroughfare, suggests the occurrence of a spring there. The line of junction of Northampton Sand and Upper Lias is entirely built upon in this area, which may account for the little evidence of springs; but getting round to the Cow Meadow they again become numerous.

Springs on the Southern Slope.

Starting at the higher level, as before, and working down towards the river, we have the following springs :—

10. At 272 feet above Ordnance Datum. Just beyond Abington, on the north side of the Wellingborough Road, in a spinney, now mostly built upon.

11. About 270 feet above Ordnance Datum. Within Abington Park was a spring known as BROADLEY HEAD SPRING. This was, and is now in part, utilized for supplying Abington Abbey with water. The spring is collected in a big underground tank whence it flows over a water-wheel, which works a pump and so lifts the water to the house some quarter of a mile away. The wheel and pump are in a "water-tower" so called, but actually the upper part of the structure, which formerly bore the date 1678 on it, was a dove house. This same spring also supplies a drinking trough on the Wellingborough Road, near at hand, and the surplus water feeds the ponds. There are other discharges of water near, at about the same level.

12. About 270 feet above Ordnance Datum. Another spring in Abington Park, south-east of the Abbey and Church, is carried through pipes underground to the ponds.

13. About 238 feet above Ordnance Datum. NINE SPRINGS WELL. On the Billing Road, just about opposite the present Victoria Road, there used to be a freely-running spring, enclosed, with perhaps a dozen steps leading down to it. The steps were needed because the road in this dip had been raised some 10 feet or so above the natural ground level.

14. At 220 feet above Ordnance Datum. ST. THOMAS À BECKET'S WELL. This freely-running spring on the south-eastern side of the town, outside the old town walls but near to the old Dern Gate, is still there to assuage the thirst of pedestrians, and although probably undeserved, it had, as late as the latter end of the last century, a certain reputation both as a drinking water and for bathing the eyes, probably because of its uniform low temperature. Even to-day people may be seen fetching this water in bottles.

The tradition that Thomas à Becket drank at this spring when fleeing from the town, on October 19th, 1165, is too unreasonable to be accepted, for, as pointed out by Dr. Cox in the Borough Records (*pp.* 261–2), it is difficult to understand a man escaping from the north gate of the town riding all round the walls to the south-east postern gate; and the sudden thirst after leaving the comfortable quarters of St. Andrew's Priory is curious. In all probability the spring was assigned to the special protection of St. Thomas of Canterbury by one of the Canterbury pilgrims in the usual manner of the early days of the Becket Shrine.

The present spring house was built by the Corporation in 1843.

15. About 217 feet above Ordnance Datum. On nearly the same level as the Becket Well, just south of the pumping station of the Northampton Corporation. This spring is useful in supplying the gardens near; a neat little water scheme gives to a number of separate cultivators easily accessible small reservoirs of water for watering purposes. The surplus water flows into Vigo brickyard, thence to the river. The amount flowing daily into the brickyard in March, 1895, was 20,000 gallons.

16. About 217 feet above Ordnance Datum. A little eastward of the last, in what is known as the "cabbage gardens."

17. About 206 feet above Ordnance Datum. Further eastward than the last, in the grounds of St. Andrew's Hospital. In the Ordnance Survey maps this is marked as "Pumping Station Northampton Waterworks." It is not, and never was this. The old Conduit Head was situated in quite another part of the hospital grounds.

18. About 200 feet above Ordnance Datum. Still further eastward, in the nursery (of maps,) now, however, part of St. Andrew's Hospital grounds.

19. About 196 feet above Ordnance Datum. VIGO SPRING, comparatively near to St. Thomas à Becket's Well, a spring of chalybeate water, was discovered in 1702, and as in this year the Port of Vigo in Spain had been captured by the combined English and Dutch Fleets, the name Vigo was given to the spring. The spring, as many people will remember, was just about where the "New Walk" makes a bend towards the river and where the steps are, though the "New Walk" is newer than the discovery of the spring. Extraordinary cures were reported to be affected by its use, and medical men praised its medicinal qualities, but the expectations of some of the inhabitants that Northampton was to become a serious rival to other Spas was not realized, and any water now finds its way underground to the river.

It is probable that this was essentially a Northampton Sand spring, the chalybeate qualities being due to the water running through boggy ferruginous ground near.

WELLS.

Ever since Northampton was established as a town, wells have been made to obtain the Northampton Sand water, and there are still numbers of wells about, some of which are old. Occasionally a sinking in of the ground reveals the presence of some old well not efficiently covered up and quite forgotten, and cases have occurred where the old wells have been converted into cesspits. One such was discovered in the cellar of a house in the centre of the town within recent years.

Before there was a public water supply, no doubt most of the larger houses of the town had private wells, but there were also numerous public or semi-public wells for smaller properties; that is to say, there were some provided by the town authorities and others by a combination of property owners.

Remains of three wells were discovered within the precincts of the old castle when it was being finally demolished to make way for the Castle Station, in 1880.

When building the new Masonic premises in Princes Street, opposite Grey Friars Street (1889), a very large well was discovered. It was about 70 feet deep and had from 10 to 12 feet of water in it.

There is an interesting account in the Northampton Borough Records of various public and private wells, from which the following particulars are taken:—

> In 1751 the "Assembly" gave leave to Mr. Henry Locock (the Mayor) and other subscribers to sink a well and erect and enclose a pump for their own use upon a piece of waste ground belonging to the Corporation at the top of the Drapery, providing that in case of public calamity or misfortune by fire the inhabitants should have free use of it for extinguishing the flames.
>
> This was followed by a like permission to eight persons to sink a well and erect a pump in the open street, at the top of Bridge Street, due care being exercised not to obstruct any of the traffic, and to "set a light on the intended pump and to keep the same constantly lighted and burning in all dark nights till break of day between Michaelmas and Ladyday for ever."
>
> A similar pump was erected in the same year as the above two in the Drapery, against the lane leading thence into the Market Hill.

Of public wells or pumps there was at least one in existence in the time of Queen Elizabeth, and between 1571 and 1745 occur orders for the repair of pumps situated respectively in the Market Place; in Mercers' Row; in All Saints' Churchyard; near St. Giles' Churchyard; and in St. Michael's Lane (now Wood Street), at the public expense. The well and pump in the Chequer or Market Square seems to have been quite a troublesome affair. First made in 1571, the pump was frequently repaired during the next 20 years. In 1593 it was converted into a drawing well, but by 1603 there was a pump once more, for in that year there was a vote of 20s. by the Assembly towards its repair, all other charges to be borne by the inhabitants living near; in 1605 the pump was again removed. Soon afterwards the well was enclosed after an ornamental fashion and roofed with lead. In 1675, apparently, there was a pump once more, for an old manuscript describing the Great Fire of the 20th of September in that year, says that "the flames spared neither cross nor pump." From this time onwards pump triumphed over draw-well continuously, so far as we can judge, for there is no mention of change in the records of the "Assembly," but in 1745 the Mayor was authorised to put the pumps on the Market Hill, etc., in proper repair.

There is some ambiguity as to the situation of this town pump. For instance, in July, 1603, the Assembly voted 20s. to be expended by the Chamberlains "For and towards the repaire of the pompe within Checker warde nigh the Corne hill [*present Parade*] there." This, considering the date, would imply a situation between the Market-cross and the Corn hill; and the Market-cross itself, according to Speed's plan of the town (1610)[1] was rather on the northern side of the square. Whatever may be the explanation; the "handsome pump" which Coles describes (1821) as occupying the site of a removed obelisk which had become a nuisance; and the one which Wetton describes (1849) as being replaced in 1826 by a "cast iron pillar surmounted by a large gas lamp," is the ornamental cast iron pump surmounted by a fluted cast iron pillar carrying a gas lamp which can now be seen doing duty at the top of the "New Walk" near St. Thomas à Becket's Well, and which stood on the Market Square where the present fountain is; that is near the centre.

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[1] *See* map accompanying "Borough Records."

Singularly, several old prints of the Market Square about 1850 show no pump or lamp, and the writer has been at some trouble in interrogating some of the older inhabitants as to whether there was or was not an interval of time when there was neither pump nor fountain (the Fountain was erected in 1863). The general opinion is that there was no such interval.

It is curious to hear people under 70 years of age talk about water-carriers going about Northampton selling water obtained from the public pumps at ½d. per bucket, and of a very bow-legged man, whom everyone called Poppet, watering the streets with a watering can, which he did with considerable skill.

The numerous modern wells will be described later on.

SCHEMES OF WATER SUPPLY.

The earliest water supply schemes of which any record exists were originated by the religious houses.

In 1291 the Dominicans or Black Friars, whose house had a frontage to the Horse Market, obtained permission from the Sheriff of the County and the Bailiffs, to construct a subterranean conduit to bring water from Trywell (the meeting of three wells) which was somewhere between Northampton and Thorpe. They had to pay compensation to owners of land. (Dr. Cox : " Northampton and the Four Orders of Friars " Lecture, 1899).

In 1292 (Nov. 13), the monks of St. Andrew's obtained permission from the King to bring a spring of water from without the town by an underground conduit into their monastery. (Rev. R. M. Serjeantson, M.A. : " The Priory of St. Andrew, Northampton," *Journ. Northamptonsh. Nat. Hist. Soc.*, vol. xiii., p. 83—from Patent Rolls, 20 Edward I., Memb. 1).

The first public water supply to the town is involved in some obscurity, for although there was a conduit, afterwards known as the Little Conduit, situated at the south-west angle of All Saints' Churchyard, that is to say, the corner nearest the present George Hotel, which is thought to have been placed there at the time of the extension and rebuilding of the town, begun in 1300,[1] there is no record of how it was first supplied with water.

The spring known as Conduit Head, on the eastern side of Northampton, was utilised after 1479, for there is a square stone at the present Billing Road (Vigo) pumping station having carved on it :—

Conduit Head	1479
Repaired	1542
Pipes laid open	1716
New pipes	1784

Rebuilt 1811 by the Corporation.

Of course this does not preclude the use of the spring to feed the Little Conduit before the first of the above dates, and 1479 may merely indicate the date of constructing a building over it, or reservoirs, or both. It is significant that the earliest of the above dates corresponds fairly well with the building of the Great Conduit on the lower or south side of the Chequer or Market Place in the reign of Edward IV., in 1461 (?) [2]

Beyond the fact that the Conduit Head was situated in the grounds of St. Andrew's Hospital, near the Billing Road, apparently no one living knew, until quite recently, exactly where the Conduit Head was. The termination of a line of pipes from it is at the present Billing Road pumping station, and Mr. Frank Tomlinson, the Borough Water Engineer, set himself the task of finding out where they lead to, and after much difficulty and the making of numerous trial holes in private grounds, he succeeded in tracing them to a built cistern some 8 feet under the kitchen floor of the lodge at the entrance to St. Andrew's Hospital grounds, that is quite close to the Billing Road. The pipes discovered were 3-inch iron ones ending in 2-inch pipes at the reservoir.

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[1] Northampton Borough Records, vol. ii., p. 253.

[2] In the Borough Records, p. 252, it is stated that three dates are specifically assigned for the building of the Great Conduit, viz., 1461, 1478, and 1481, of which Dr. Cox thinks the latter to be correct, but this does not agree with a specific statement about the building of a room over the Great Conduit in 1460 (p. 171, Borough Records).

The following remarks embody Mr. Tomlinson's opinions as well as the writer's on the subject of this early water supply to Northampton. A spring existed on the site of the old Conduit Head, the water from which flowed down the depression which forms the western boundary of St. Andrew's Hospital grounds, and actually does so now in part, though underground, being the source of the "cabbage gardens" spring. This is the nearest good spring that could possibly flow into the centre of the town by gravitation, all others being at too low a level. Still the fall from this one is so slight, only three or four feet at most to the Market Square, that in all probability people had to go down several steps in order to catch the water in the Great Conduit.[1]

Mr. Tomlinson thinks that at first the conduit was an open ditch cut to follow the contour of the ground in the open fields surrounding the town, and if so it would naturally go round the hill near the present Billing Road pumping station, then cross over to the north side of the Billing Road, and back to the south side, where the present General Hospital is, entering at or near the Dern Gate. Thence it is reasonable to suppose the water must have been conveyed by pipes underground to the conduit houses.

The item on the stone at the waterworks, "Repaired 1542" may refer to the Conduit Head only, but evidently before 1716 pipes had been laid, probably wooden pipes merely laid in the trench for the better protection of the water; but non-jointed pipes of any material laid in such a situation would ultimately get choked with vegetation, and this is perhaps the meaning and object of laying open of the pipes in 1716. Wooden pipes of about 4-inch bore have been dug up at various places.

The new pipes laid in 1784 were probably leaden ones of 2½-inch bore, for such a pipe was found crossing the site of the present post office when digging out for the foundations. Of course this particular pipe might have been an earlier insertion, for a large leaden pipe was used to connect the Great and Little Conduits in 1630.

Returning to the general water scheme—The Little Conduit was an ornamental octagonal structure, with pierced parapet and pinnacles, though the latter are not shown in any of the illustrations preserved. The Great Conduit appears to have comprised a hall or assembly room built upon arches, known as the Conduit Hall, in which at one time the several trades having constitutions or companies used to meet for considering offences committed to the injury of their business. But the arches were ultimately filled up with shops, and a portion, for a time, was used as a bridewell. In 1686-7 the Assembly voted money for the making of houses and shops at the old Conduit, and ordered that the West Gate should be taken down and the stones and materials be used for this purpose.

Borough officials were annually appointed to look after the conduits, who were known as "Masters of the Conduits," "Key-Bearers," or some similar appellation.

For the reconstruction, maintenance, and repair of the conduits and pipes, rates were made from time to time on assessment.

In 1608, an exceptionally dry year, it was deemed necessary, in August, to restrict the use of the water, and the Assembly authorized the conduit masters to shut up the conduit at seven o'clock in the evening and to keep it locked till six o'clock the next morning, and again from ten to two in the daytime. Orders were also given that no townsman himself or his servant was to bring more than one cowle or tub to fill at a time, and he was to quietly wait his turn at the conduit, and no cowle or tub must be used that would not stand upright under the conduit cock.

In 1630 owing to the scarcity of water it was found necessary to make a charge to innkeepers and victuallers for water for brewing. The charges were 2s. 6d. to an inn-keeper, 12d. to every alehouse-keeper for each brewing, and they were under the same restrictions as other people as to the size of the vessel they could bring. The levies for water for brewing were to be made by the conduit master, and the fines for irregularities by the same master and the thirdborough of the Checker Ward upon a warrant under the Mayor's seal, and the conduit master was held reponsible for enforcing the fines under a penalty of 5s. for every negligence. The conduit master evidently did not have an easy task, for in 1652 the Assembly stiffened the regulations and increased the penalties for disobedience.

A large lead pipe connected the Great Conduit with the Little Conduit and some smaller lead pipes were "grafted" on it to supply adjacent houses with water, for in 1630 one such was ordered to be cut off, and in 1684 an order wa made prohibiting any branch pipes or connections from either of the conduits.

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[1] When the conduits were replaced by a cistern on Wood Hill, the water had to be pumped from the cistern.

From this time onwards the various references to the conduits show that the system was inefficient and was gradually being superseded, or at least added to, by other methods of obtaining water. (*See* other schemes.)

In 1752 the governor and trustees of the County Hospital (then in George Row) were granted the privilege, at their cost and charge, of conveying the water running waste from the Great Conduit to fill and supply a large cistern lately made at the hospital and intended to be used as a cold bath.

In 1830, on the petition of a committee desirous of erecting a wall and iron rails round All Saints' Churchyard to be allowed to remove the Little Conduit at the south-west corner, the Assembly appointed a committee to survey and consider the propriety of doing away with both the Great and Little Conduits and to construct one large tank.

In 1831 the committee advised the construction of a large tank holding at least fifty hogsheads, on Wood Hill, at the south-east angle of the churchyard. By August of this same year the new tank and pumps had been completed, and the public seemed quite satisfied with the new arrangement.

Thereafter there was no water in either of the conduits, and the Little Conduit was soon demolished for the improvement desired; the Great Conduit disappeared in 1833.

OTHER SCHEMES.

From time to time other schemes for supplying the town with water were proposed. For instance, in 1656, Mr. Thomas Morgan and Mr. Francis Cook and other inhabitants of Kingsthorpe sought permission of the Assembly to bring the spring called SWARBUTTS HEAD to Northampton by a large pipe, and to arrange for a small rent as an acknowledgment for breaking the ground and bringing the water.

In 1689 the Assembly gave power to Mr. Richard Raynsford and others to break up the ground in the streets and other places for the pupose of conveying water to the town, and to open up and secure any springs upon void grounds. Nothing came of this.

SCARLETWELL WATERWORKS.

In 1691 Richard Raynsford, Francis Arundel, and others acquired from the town the piece of ground adjoining the north side of the waterworks near Scarlet Well, for £10. Works for the supply of the town with water were commenced, but were not completed in 1703, for in that year the Assembly ordered that as soon as three substantial workmen shall certify that the pipes are in good order and sufficient to convey water to all persons that ever rented water, that then and for so long as the water work is in good order no person shall fetch water from either the Great or the Little Conduit, in any vessel that will hold more than five gallons, etc.

In 1708, Messrs. Raynsford and Arundel having failed to satisfactorily complete the scheme for supplying the town with water from Scarlet Well, two other persons expressed their willingness to undertake the completion of the works, and permission was given them to do so on payment of £200 to the old contractors, or in case the latter would not agree to this, to indemnify the Corporation from any suits or charges that might be brought against them.

The orders of the Assembly show that in 1712 Alderman Agutter had bought the old waterhouse and works and grounds, and that he bought a small plot of land on the north-east of the waterhouse from the Corporation on the nominal payment of 5s. By 1717 this scheme was recognised to be a failure.

MR. WYKES' SCHEME.

In 1719, both of the schemes of water supply then in existence having proved inadequate to the needs of the town, Mr. William Wykes, of Haslebeech, made a proposal for a complete water supply, which was accepted. Mr. Wykes was given considerable powers and privileges; he was permitted to use the river, streams, and springs as he thought best, and to use all old cisterns and pipes throughout the liberties. In 1720 he was assigned full control of both conduits, and had in his hands the appointment of conduit masters, but he was not to hinder people, using the conduits until his own scheme was complete and the pipes fully supplied, nor when they were out of order; and the waterworks were not to be taxed to the public or parish taxes. As the work was to be undertaken at his own cost, Mr. Wykes was permitted to get what he could as rent from those he supplied.

In 1721 it was announced that the works were nearly finished, and a further covenant was made with Mr. Wykes confirming the former grants, and prohibiting the inhabitants from drawing more than three gallons of water from the old conduits in one day.

The *Northampton Mercury* of December 7th, 1722, contains the following paragraph. "This town having ever laboured under the misfortune of a scarcity of water (as the great conflagration about forty-six years ago, when the town was almost burnt to ashes, can too well testify), William Wykes, Esq., one o our late candidates (to verify his great veneration for us), undertook to supply us with that useful element, from a place about half a mile distant from hence, which was thought impossible by many; but after the expense of some thousand pounds, and about nine months time, it was happily effected by the force of an engine; and this day the pipes began to run to the general satisfaction of the town; who thereupon immediately caused all the bells to ring, to show their joy and thankfulness, and to sound the praise of that worthy gentleman, for this his glorious and ever memorable benefaction to the town, which has so dearly paid for the want of it."

No particulars whatever are available as to the character of Mr. Wykes' scheme, but the following quotation from Wettons' Guide-book to Northampton (1849):—"Nearly opposite to St. Thomas à Becket's Well are traces of the Old Waterworks, the first which were constructed to supply this town by mechanical aid," set the writer on a search of old maps and oddments of information with the result that, so far, everything points to Vigo as the situation of the works, and to the three springs Thomas à Becket's Well (overflow), Nine Springs Well (No. 13), and the Vigo Brickyard Spring (No. 15) collected in a pond, as the source of water. The pumping power was derived from a windmill; the present dilapidated ivy-covered old round tower at Vigo. The Engineer was Mr. Henry Mill, who, for his services, was presented with the freedom of the town at a Meeting of the Assembly on December 12th, 1722.

In 1728, in consequence of the principal inhabitants being "put to great inconveniences by their servants waiting so long before they can get any water occasioned chiefly by persons fetching water to sell, and for washing and brewing in great quantity contrary to the ancient customs and usages of this Corporation," Mr. Wykes was ordered to direct his conduit keepers to prevent anyone from fetching water from either of the conduits for selling, washing, or brewing, and keep the conduits open but three hours in the morning and three in the afternoon. His works were abandoned in 1753.

Notwithstanding all the devices adopted for obtaining water in other ways, as will be perceived, the Great and Little Conduits played an important part down to 1831.

Billing Road or Vigo Waterworks.

The Northampton Waterworks Company was incorporated in 1837, and they acquired the right to use the overflow only of the Conduit Head, which was carried by pipes to a storage or pumping reservoir constructed on the site of the present pumping station. Thence the water was conveyed to a service reservoir on the Mounts, on ground now occupied by the jail (the recently-added portion adjoining Robert Street). The top-water level in this service reservoir was only 297 feet above Ordnance Datum, but there was a stand-pipe going 18 feet higher.

The water company in acquiring the overflow from the Conduit Head agreed to maintain existing pipes supplying the cisterns on Wood Hill and in Jeyes' Jetty. This arrangement was difficult and expensive to carry out, and so, in 1868, the Corporation agreed to the water company taking the whole Conduit Head spring in consideration of their undertaking to always supply the two places above named.

Soon after the tapping of a large volume of water in the old Kingsthorpe Shaft (*see* Kingsthorpe), wells and borings to the Marlstone began to be made in Northampton (*see* record of a number to follow), and in 1846 the waterworks company decided to make a deep well. The well was made and water became available in 1848, and about 500,000 gallons per day was obtained.

Because of the increasing demand for water and the diminishing yield from the above well through over-pumping the permanent supply, a second well was made in 1864, but owing to the water breaking through before the lining was completed, this was abandoned.

A third well was commenced the next year and completed in 1866, and a total yield of 860,000 gallons per day was obtained; but in 1871 the supply had again diminished from the same cause as before, to some 284,000 gallons per day, which for 45,000 people was only 6·3 gallons per head (Haviland).

The water company set to work to increase the supply in various ways: they deepened the Vigo Well, increased the headings, made a boring to the Marlstone near the new service reservoir in Stimpson Avenue without success, made a deep well and boring on the Kettering Road to try to reach the Keuper Waterstones, and this proving a failure, made another deep boring at Gayton, which was also a failure.

Meanwhile, by various temporary devices and the tapping of several small supplies of Northampton Sand water around the town on the north-east, and particularly at a place known as Lumber Tubs, the supply was brought up to about 420,000 gallons in 1885, 315,000 of this being from the Billing Road (or Vigo) Well.[1] This for 60,000 inhabitants was about 7 gallons per head.

During this critical period, in 1884, the waterworks undertaking was taken over by the Northampton Corporation, and the responsibility for providing a larger supply of water devolved on them.

The proposal to construct a large reservoir in the valley between Teeton and Ravensthorpe was met by an alternative proposal by Mr. Beeby Thompson, to use the much larger natural reservoir underground (the Marlstone) which had lasted some 40 years, although the Corporation had been pumping more out of it than naturally got in, in the same period of time. This natural reservoir might be replenished by letting water into it in suitable localities, by means of dumb wells or artificial swallow holes.[2]

Ultimately a reservoir was decided upon, and its construction was commenced in 1886. Its situation is in the valley eastward and north-eastward of Ravensthorpe, some 8 miles from Northampton. The catchment area is supposed to be about 3,000 acres, within which are numerous Northampton Sand springs. When full the water covers about 113 acres, but the area is rapidly diminished as the water falls, owing to much shallow water round the margin. It is computed to hold 400 millions of gallons, and the greatest depth near to the embankment is 27 feet. The water is pretty good after efficient filtration, but not high class.

There are two large service reservoirs near Stimpson Avenue in Northampton holding respectively 2,000,000 and 1,000,000 gallons, and these are fed when the pumping from Ravensthorpe into the town service mains exceeds the demand on them. For some of the higher parts of the town there is also a water-tower with tank holding 50,000 gallons. The Billing Road pumps now deliver direct into this, although formerly there used to be a double pumping for the purpose.

By giving the Billing Road Well a rest when the reservoir is high, and by the installation of a separate non-domestic supply of water from the river gravel for watering the streets, and for manufacturing purposes, a good water service has been maintained. The total amount of water used is approximately 1,500,000 gallons per day, which for 90,000 people equals about 16 gallons per head.

Still, in a dry year the reservoir gets very low; 1902 was such a year, and on January 1st, 1903, the water stood 10 feet 7 inches below the overflow sill, and it was estimated that there was only 130,000,000 gallons in the reservoir, and of this perhaps 40,000,000 gallons would not be available. Actually the reservoir was overflowing on January 1st, 1904, after a rainfall of 32·6 in. over the gathering ground, but on January 1st, 1905, it was again at 10 feet 4 inches below the sill. The alarm created by the deficiency recorded has caused other works to be thought of, and this was the origin of the Marlstone well made near to the reservoir of which a detailed account is given under Ravensthorpe.

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[1] The pumping of 150,000,000 gallons in a year reduced the head of water permanently 18 feet, therefore the permanent yield at the present time is under, but not much under, 400,000 gallons per day, say, 380,000 (Mr. F. Tomlinson, May, 1902).

[2] For account of the Scheme *see* "The Middle Lias of Northamptonshire," by Beeby Thompson. Reprinted from the *Midland Naturalist*.

Evidence has been accumulating for a number of years in favour of the view that the Marlstone at Northampton is not fed direct by percolation of rainfall over the Marlstone outcrop, or at least very little so.

NORTHAMPTON WELLS AND BORINGS.

One-inch map N.S. 185 ; Geol. map 52 ; Six-inch map 45 S.W.

DRIFT GRAVEL WELLS.

Only one true Drift gravel as distinct from River gravel. Spring in Northampton is known to the writer.

1. Well in Lower Thrift Street, eastern end of town near to cemetery, premises of Mr. Spencer, cab proprietor.

Communicated by Mr. Beeby Thompson from information supplied by Mr. "Jack" Pearson.

Top approximately 266 feet above Ordnance Datum.

		Ft.	in.
Sand - - - - - - - -	5ft to	6	0
Gravel—rounded pebbles, with much water - - - - - - -	19ft to	20	0
		25	0

NORTHAMPTON SAND WELLS.

Communicated by Mr. Beeby Thompson.

2. Well near to Reservoirs, Stimpson Avenue.

From information by Mr. F. Tomlinson.

Top 325 feet above Ordnance Datum.

	Ft.	in.
Upper Estuarine beds Northampton Sand - - - - - -	61	4
Blue Clay bored into 18 feet.		

This well, made in 1878, was used largely by the water company and the town during the critical period 1878 to 1890. The yield of water is very variable ; it has been so much as 180,000 gallons per day, but there is a rapid decline with exhaustive pumping to a minimum (?) of 10,000 gallons. It is now only used at times as a non-domestic supply by pumping direct into the special mains.

It is interesting to note that this is a "blowing" well like Mr. Watkin's well at Duston. There are several fissures in the Northampton Sand rock, the largest opening towards the south-east, and sometimes there is a strong draught into the well and sometimes out of it, through these fissures, enough to blow a candle out. Since the well is covered on the site by impervious beds, and any outcrop of Northampton Sand must be a considerable distance away, wind or changes in atmospheric pressure seem inadequate causes. The probable cause is a displacement of air by water along the crevices when the bed is filling up with water, and a suction inwards when the water-level is falling through pumping or for any other reason.

3. Messrs. Dorman and Pope's Brewery, towards Abington Park.

Well. Top 229 feet above Ordnance Datum.

	Ft.	in.
To the water - - - - - - - -	30	0 ?
Water - - - - - - - - -	10	0
	40	0 ?

The depth is 38 to 40 feet, mostly in the Northampton Sand. The Upper Lias Clay was not reached, and the lowest beds got out were almost a limestone, being only ferruginous at the joints. Yield daily about 10,000 gallons. Temperature 49° F.

4. Mr. James Collier's Leather Factory, DUNSTER STREET.

Well actually in cellar about 10 feet below street level.

Top about 289 feet above Ordnance Datum.

	Ft.	in.	Ft.	in.
Northampton Sand chiefly or entirely, red ironstone towards bottom ; blue stone just before reaching the clay	70	0 ?		
Upper Lias Clay	6	0	76	0 ?

Water does not rise much above the clay, 6 to 8 feet of water altogether. There would appear to be some mistake about the depth of this well; it agrees very badly with Nos. 4 and 5 which are comparatively near.

5. VICTORIA BREWERY, Kettering Road.

Beeby Thompson. *Journ. North. Nat. Hist. Soc.*, vol. xii, p. 63.

Well. (1896). Top about 286 feet above Ordnance Datum.

	Ft.	in.	Ft.	in.
Northampton Sand	30	0		
Upper Lias Clay	3 to 5	0	35	0

This was made on the advice of a Diviner, some 30 yards only from an older well about 36 feet deep. Very little water was obtained. Never used.

6. ICE FACTORY, Abington Square.

(Messrs. Major Lucas & Co.)

Communicated by Mr. Beeby Thompson.

Well. Top about 282 feet above Ordnance Datum.

	Ft.	in.
Made ground and Northampton Sand, very hard, and fossiliferous near the bottom	43	0
Upper Lias Clay	6	0
	49	0

Water stands 33 feet from surface after rest.

7. NORTHAMPTON GENERAL HOSPITAL. Well close to Mortuary and Wash-houses.

Top 254 feet above Ordnance Datum.

	Ft.	in.
To water	30	6
Water	6	4
	36	10

8. Old Well in Wood Cellar.

Top about 244 feet above Ordnance Datum.

	Ft.	in.
To water	22	6
Water about	3	0
	25	6

Both of these wells are near to St. Thomas à Becket's Well. (*See* Springs.)

9. Well at ELECTRIC LIGHT WORKS (Engine-room well).

Top about 221 feet above Ordnance Datum.

	Ft.	in.
To water	13	9
Water	8	0
	21	9

Two headings in the clay 5 feet by 2 feet, so that the Northampton Sand goes down about 15 feet 9 inches, but most of the ground has been made up.

10. GOLD STREET. At back of Mr. Ashford's, Chemist.

Well. Top about 234 feet above Ordnance Datum.

	Ft.	in.
To water (1898)	25	9
Water	4	0
	29	9

St. James' End.

In the part of Northampton beyond the West Bridge known as St. James End,[1] wells may obtain water from the River Gravel under a variable amount of Alluvium, the gravel resting on Upper Lias Clay. Further from the river, however, at a higher level, River Gravel rests directly upon Northampton Sand as may be seen now (1908), under the hedge on the southern side of the Weedon Road, just beyond where it branches off from the Harlestone Road.

11. Well at Mr. Simon Collier's Factory.

Communicated to Mr. Beeby Thompson by Mr. "Jack" Pearson, workman for Mr. Henry Green.

Top approximately 202 feet above Ordnance Datum.

		Ft.	in.
	Soil	4	0
River Gravel-	Gravel	25	0
Northampton Sand.	Ironstone	3	0
		32	0

Plenty of water comes from the ironstone. Assuming the description of the above is correct, this is the lowest level at which Northampton Sand has been encountered about Northampton. (173 feet above Ordnance Datum.)

Harlestone Road.

(Six-inch map 44 N.E.)

A very low level for the base of the Northampton Sand is maintained for a considerable distance in a north-westerly direction in the suburb of Northampton extending along the Harlestone Road, as will be seen by the following wells.

12. Well at corner of roads leading to Dallington and Duston respectively. (By Mr. Sharp.)

Top approximately 276 feet above Ordnance Datum.

	Ft.	in.
Northampton Sand, Clay not reached	68	0

13. Well on east side of road further along.

(Mr. Shuttleworth's.)

Top about 285 feet above Ordnance Datum.

	Ft.	in.
Northampton Sand, not bottomed	66	0

Water rises 9 feet

14. Well on west side of road a little further along.

(Mr. F. Watkins'.)

Top about 281 feet above Ordnance Datum.

	Ft.	in.
Northampton Sand, not bottomed	65	0

About 12 feet of water.

MARLSTONE WELLS.

15. Brettel's Well and Boring.

(Messrs. Mobbs' Foundry (Cow Lane.)

Made about 1836.

Journ. North., Nat. Hist. Soc., Vol. i., p. 225 (Thompson); 291 (Sharp); Vol. iii., p. 6 (Thompson); p. 171 (Eunson).

Top 229 ft. above Ordnance Datum.

	Ft.	Ft.
Northampton Sand	30 ?	
Upper Lias	148 ?	
Marlstone rock-bed	?	178

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[1] From St. James' Abbey formerly existing there.

This was sunk 104 feet and bored 74 feet, and according to a chart at one time in the Town Surveyor's (Mr. Pidcock) office, which gives the depth as 170 feet, the water rose to within 30 feet of the surface (199 feet above Ordnance Datum) and then ran away into a kind of ragstone (evidently Northampton Sand). A chart in the writer's possession gives the water-level as 38 feet below the surface (191 feet above Ordnance Datum.). It is doubtful if the Marlstone was actually penetrated (*Cf.* Electric Light Works Well).

16. BARRACKS YARD WELL.

Journ. North. Nat. Hist. Soc., Vol. i., p. 224 (Thompson).

Top 262 feet above Ordnance Datum.

	Ft.	in.
To water	44	0
Water	130	0
	174	0

Consequently the bottom is 88 feet above Ordnance Datum, and this is likely to be the top of the Marlstone.

17. BARRACKS YARD WELL AND BORING.

Journ. North. Nat. Hist. Soc., Vol. i., p. 224 (Thompson).

Top 261 feet above Ordnance Datum.

	Ft.	in.
Sunk	140	0
Bored	106	0
	246	0

The water stood 66 feet from the top (195 feet above Ordnance Datum), but it is impossible to tell the depth from which it came, from the description, though in all probability it came from 88 feet above Ordnance Datum, the same as in the well just described, which gives the total depth of water as 107 feet.

18. OLD COUNTY JAIL WELL.

Journ. North. Nat. Hist. Soc., Vol. i., p. 224 (Thompson).

Top 239 feet above Ordnance Datum.

	Ft.	in.
Sunk	102	0
Bored	72	0
	174	0

The water stood 22 feet from the surface (217 feet above Ordnance Datum), when first made; so this is probably the thickness of the Northampton Sand there. Again, since the boring would probably stop as soon as water was found, the Marlstone Rock may be considered to be at 65 feet above Ordnance Datum. (*Cf.* Electric Light Works Well).

NORTHAMPTON WATERWORKS WELLS.

In 1846 it was proposed to make a well and boring to the Marlstone and below on the site of the existing Northampton Sand water supply of the Northampton Waterworks Co., at Vigo. The well was to be sunk 120 to 150 feet and the boring to be continued 120 to 130 feet.

The well and boring was made, and water from it became available in 1848. The water rose to within 70 feet of the top (about 174 feet above Ordnance Datum), and amounted to about 500,000 gallons per day.

The account of this well given by Mr. Samuel Sharp (*Journ. North. Nat. Hist. Soc.*, Vol. i. p. 292) is that "this well was sunk to the depth of 150 feet, and a bore hole of 21 inches diameter was sunk to a further depth of 18 feet."

The only detailed account of this well that the writer knows of is in a pamphlet by Mr. Baldwin Latham, M.Inst.C.E.[1] He says (p. 47), "Northampton is supplied with 518,400 gallons of water per day from a well partly sunk and partly bored 250 feet deep into the Lias formation."

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[1] "Papers on the Water Supply of Towns." Spon, 1865, pp. 47-50, with Diagram Plate v. *f.* 7.

19. Section of Vigo well given by Mr. Latham, *op. cit.*, p. 50.

	Ft.	in.	Ft.	in.
1. Made ground	3	0	3	0
2. Rubble stone	13	9	16	9
3. Stone	6	0	22	9
4. Blue clunch	135	3	158	0
5. Hard stone	14	3	172	3
6. Clay stone	18	6		
7. Stone	0	9	191	6
8. Clay stone	35	6		
9. Stone	3	0	230	0
10. Clay stone	23	3	253	3

The description of the work is very detailed, but does not quite agree with the above, perhaps the lining did not go full depth of boring ; it is as follows :—

The well is steined with brickwork and iron cylinders in the following order :—

Sinking.	Ft.	in.
Brickwork, 7 ft. 6 in. diameter	16	9
Two cast-iron cylinders 5 ft. 6 in. diameter 9-inch brick steining commencing at 5 ft. 6 in. diameter internal, and widening out to 7 ft. 6 in. diameter Floor of the well in brickwork at 120 ft. from surface. Boring commences in this floor	103	3
Boring.		
Lined with 14-in. pipes which rise into well 5 ft. above the floor	31	0
Remainder 9-in. pipes	89	0
	240	0

A second well was made in 1864, but owing to water breaking through the clay when there was some 15 feet at the bottom unlined, and it seemed a hopeless task to make a good job of it although divers were employed, the well was abandoned.

A third well was sunk within 40 feet of the first one, and was got to work in 1867. The total yield of water then amounted to 860,000 gallons per day. The following is a description of this well by Mr. Alexander Milne in a letter to Mr. Samuel Sharp, dated Jan. 29th, 1870 (with slight explanatory addition by the writer).

20. Vigo Waterworks Well. Top 246 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
		Made ground	14	0		
		Soil	2	0	16	0
Northampton Sand		Brown stone-rubble	4	0		
		Brown rock with water in lowest portion	2	0	22	0
Upper Lias 142 ft. 4 in.		Hard blue clay clunch which required blasting with powder. Many small shells in it	135	0		
	Communis Beds.	Dark sand and water	0	9		
		Hard grey blue stone which had, I think, some water in it, but cannot be certain	1	0		
		Blue clay	1	0		
		Blue stone and clay	0	9	160	6
Marlstone, &c.		Very hard green grey rock	7	6	168	0

Of the 7 feet 6 inches very hard green grey rock, I consider that about 3 feet 10 inches belongs to the Upper Lias (*see* page 135), hence the Upper Lias here would be 142 feet 4 inches thick.—B.T.

1874. The water having been for some years diminishing in the wells, and the water-level having sunk from 70 feet from the surface to 130 feet from the surface, it was determined to deepen the well, and as the water stood 20 feet in the well the deepening was effected by divers (Sharp, *Journ. North. Nat. Hist. Soc.*, Vol. i., p. 292).

1881. Exhaustion still went on, and the supply is now, I believe, drawn entirely from the bore hole (Sharp, *Journ. North. Nat. Hist. Soc.*, Vol. i., p. 292).

1882. The writer went down the Vigo well, by permission of Mr. John Eunson, the engineer to the water company, when headings were being driven on the top of the Marlstone rock-bed, and he could walk along them without treading in water, the water running along a trench and being pumped from a sump. The section then measured was as below, and it will be seen to differ somewhat from either accounts left of the sinkings. (*Journ. North. Nat. Hist. Soc.*, Vol. ii., p. 203, Thompson).

			Ft.	in.
Upper Lias.	Communis Beds.	Cephalopoda-bed forming the roof of the heading, sparkling with freshly exposed pyritous ammonites Clay	2	8
	Serpentinus Beds.	Hard bed with few fossils	0	9
		Clay	2	6
		Fish-bed, joined on to the rock below 5 in. to	0	6
Middle Lias.		Marlstone rock.		

21. KETTERING ROAD.

Well and Boring (Spinney Well.)

In the parish of Kingsthorpe, before the extension of the Borough boundary.

Geol. map 52 S.W. ; One-inch map New Series 185 ; Six-inch map 45 N.W.

Made by Northampton Waterworks Company. 1876 to 1879.

Sunk 403 feet. Bored 448 feet.

Henry John Eunson, "The Range of the Palæozoic Rocks under Northampton," *Q. J. G. Soc.*, Vol. xl., pp. 482–485 ; *also* De Rance, *Rep. Brit. Assoc.*, 1878.

Height above Ordnance Datum 278 feet.

(First made as a Marlstone Well.)

Corrected and re-arranged by Mr. Beeby Thompson.[1]

			Thickness. Ft.	in.	Depth Ft.	in.
Northampton Sand.		Soil, yellow clay, and ironstone or sandstone. Slipped material	18	0	18	0
Upper Lias.		Blue clay	143	0	161	0
		Green rock with fossils	2	0 ?		
		Hard clay (binds) with fossils	2	6 ?		
		Green rock ,,	0	6 ?		
		Rock binds	3	6 ?		
		Paper Shales and Fish-bed	1	6 ?	171	0
Middle Lias 100 feet ?	Upper.	Rock-bed. Hard green rock, with fossils	4	0 ?	175	0
		Strong rock binds	5	0		
		Hard rock binds (laminated clay)	3	6		
		Binds. Clay bands with joints	8	0	191	6
		Hard grey rock	2	6	194	0
	Lower or Nitescens Zone.	Rock binds—hard clay	3	6		
		Light-coloured rock or bastard stone	1	6	199	0
		Strong binds. Clay with ironstone, many fossils	20	0	219	0
		Argillaceous rock	0	9		
		Blue clay with *A. margaritatus* and other fossils	8	3		
		Light argillaceous rock	1	0		
		Blue clay	8	6	237	6
		Thin band of light-coloured rock	0	6	238	0
		Blue clay (strong bind shale) with fossils	33	0	271	0

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[1] It was quite impossible to accept the individual thicknesses of the various beds given by the workmen for the first (10 foot) well, which was carried down to 203 feet. Every hard bed had an exaggerated thickness given to it. The corrections in this report are based on personal observations of the same beds in the neighbourhood. Aggregate thicknesses were probably correct in the first instance.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Lower Lias 467 feet. ?		Bed of microscopic shells. *Junction bed* ?	0	2	271	2
		Blue clay	3	10		
		Light rock	0	4		
		Clay with fossils	0	6		
		Shell bed	0	2		
		Blue clay	4	0		
		Shell bed	0	2		
		Blue clay with fossils	17	10	298	0
		Shell bed	0	2		
		Clay with fossils	25	4	323	6
		Hard light rock	0	2		
		Limestone with fossils	1	6		
		Blue clay	10	6		
		Limestone	0	10		
		Clay	3	0		
		Limestone	1	4		
		Blue clay	83	4	424	2
		Rock. Claystones with fossils	18	0		
		Blue clay with claystones	49	0	491	2
		Rock	1	0		
		Blue clay	83	6	575	8
		Rock	0	6		
		Blue clay	43	6	619	8
		Rock	0	6		
		Blue clay	44	6	664	8
		Rock	0	4		
		Blue clay	16	2	681	2
		Rock	0	6		
		Blue clay	31	0	712	8
		Limestone	1	6		
		Blue clay	9	0		
		Rock	0	3		
		Blue clay	8	9		
		Limestone rock	2	0		
		Blue clay	4	0		
		Hard rock	1	0		
		Blue clay	2	0	741	2
		Actual			738	0
Rhætic 27 feet.	Littoral Beds.	Conglomerate of sandstone with calc-spar, chert, and quartz, very hard	12	6	750	6
		Light blue sandstone with limestone and chert	8	6		
		Light-coloured sandy limestone with magnesian limestone	6	0	765	0
Trias, 40 feet 6 inches.		Green sandstone with hard and soft veins	8	0	773	0
		Dark green sandstone	5	0		
		Hard white sandstone	9	0		
		Green sandy clay	0	6		
		Hard white sandstone	1	0		
		Green sandy clay	3	0		
		Light brown, fine grained sandstone	3	6		
		Brown sandstone, coarser	3	0		
		Yellowish green marl	3	0	801	0
	Littoral Beds	Variegated conglomerate, fine grained, in calcareous matrix, with garnets ? &c.	2	6		
		Brown marl with blocks of Dolomite containing *Orthoceras oblatum*, &c.	2	0	805	6
		Old Land Surface at 527½ feet below Ordnance Datum. Dipping at an angle of 15°, but direction unknown.				
Lower Carboniferous, 45 ft. 6 in.		Red dolomite, fissured, with eroded upper surface. Fissures yellow with impure calcareous matter	2	0	807	6
		Vein of white dolomite	1	0		
		Dull red dolomite, very dense, jointed, containing a vein of quartzite towards the base	22	0	830	6
		Yellow sandstone, with corals	2	6		

		Thickness. Ft.	in.	Depth. Ft.	in.
Lower Carboniferous, 45 ft. 6 in.	Vein of red sandstone with fossils more numerous	1	0		
	Yellow sandstone with corals	2	0	836	0
	Dense orange-coloured limestone with calc-spar	0	6		
	Yellow limestone, fossils numerous, corals, &c.	7	6	844	0
	Yellow, sandy shales with plant remains	1	0		
	Band of black, sandy shale	0	6		
	Yellow shales with various fossils. Fish scales and wood, &c.	5	6	851	0

No water was obtained from the Marlstone (or any portion of the Middle Lias) in this sinking and boring, owing to the exhaustive pumping that had been and was going on at the Vigo pumping station from the same rock at a lower level, 25 to 30 feet?

Mr. H. J. Eunson says that the salt water from the Trias appeared to have a level of about 150 feet abeve Ordnance Datum. This is rather improbable considering that it has a level of 104 feet above Ordnance Datum at Kingsthorpe, only a short distance away; but may be possible under particular circumstances.

22. TOWER BORING.

Boring near to the Service Reservoir of the Northampton Corporation, Stimpson Avenue.

From information by Mr. Frank Tomlinson.

Between the completion of the first part of the Kettering Road well and the later boring there, in 1877–8, a boring was made to the Marlstone near to the service reservoir and water tower; but no water was ever pumped from it, the quantity was too small.

Top, 325 feet above Ordnance Datum.

Depth - - - - - - - - - 230 feet.

Assuming they stopped on reaching the Marlstone, the Marlstone here is about 95 feet above Ordnance Datum, which is consistent with the record of the other wells and borings.

23. New Well of Northampton ELECTRIC LIGHT AND POWER COMPANY, near Angel Lane.

Communicated by Mr. Beeby Thompson.

Top about 216 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
		Soil	4	0	4	0
	Northampton Sand.	Rubbly ironstone with about 1 foot of hard rock at the bottom. Practically no water	6	0	10	0
Upper Lias 155 feet 8 inches.		Ferruginous clay, weathered, with a few lumps of ironstone (slipped material)	7	0		
		Blue clay with numerous fossils	139	0	156	0
	Communis Beds.	Slaty rock	1	0		
		Hard rock with numerous ammonites, yielding some *water*	1	0		
		Clay	2	6	160	6
	Serpentinus Beds.	Oolitic rock	0	4		
		Clay with numerous ammonites towards the bottom	3	5	164	3
	Fish Beds.	Paper shale—hard as rock, numerous fish remains	0	6		
		Fish-bed, good typical	0	3		
		Paper shale, hard, finely laminated with fish remains	0	8	165	8
		Irregular junction.				
Middle Lias.	Transition Bed.	Brown to grey limestone with *Ammonites acutus*, 3 inches to 5 inches	0	11	166	
	Marlstone Rock-bed.	Hard grey oolitic limestone with *Rhynchonella tetrahedra* and various sized pebbles, 6 inches to 8 inches				
		Soft rock crowded with *Protocardium truncatum*, 4 inches to 6 inches	0	5	167	
		Grey micaceous clay—upper part one mass of crushed fragmentary shells				

The last six hard beds formed one block of stone about 2 feet 9 inches thick. Actually they varied from 2 feet 2 inches to 3 feet within the width of the well. The most irregular part is the rock-bed proper.

The beds dip S.E. by S., or nearly S., and so towards the Fault.

Water first broke through at 157 feet, and increased as the well was deepened, ultimately coming from the rock-bed.

Quantity of water about 60,000 gallons per day at first, and rose about 35 feet, but increased in quantity and head when the Billing Road well was resting.

24. MESSRS RATLIFFE AND JEFFERY'S WELL AND BORING.

Commercial Street.

Top about 195 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
	Made up ground	6	0		
Upper Lias	Blue clay	75	0	81	0
	Blue rock, hard	1	0	82	0
	Blue clay	7	0	89	0
Middle Lias?	Rock	3	0	92	0
	Clay	5	0 ?	97	0

Water obtained through 8½-inch pipe. Assuming that the water comes from the 3-foot rock, then the water bearing rock is at about 106 feet above Ordnance Datum. Presumably this includes the Marlstone, and if so the well is on the northern side of the fault, but the Ordnance Datum level of the rock does not reasonably agree with the nearest known Marlstone. (*Cf.* No. 23).

MIDDLE LIAS AND RIVER GRAVEL WELLS.

One-inch map N.S. 185; Geol. map 52 S.W.; Six-inch map 45 S.W.

THE NORTHAMPTON BREWERY CO.'S WELLS.

From information supplied to Mr. Beeby Thompson by Mr. W. Bird, and others

25. Boring made near the river, in premises along Weston Street.

Top about 194 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
River deposits.	Old well	15	0	15	0
	Gravel	13	0	28	0
Upper Lias.	Blue clay	11	0	39	0
Middle Lias and a little Lower Lias perhaps.	Hard blue rock with shells and small pebbles	0	6	39	6
	Greenish sandy clay	4	6		
	Bluish stones, or concretions	0	8		
	Blue clay	96	4	141	0

Water was obtained from the hard blue rock at 39 feet 6 inches down (155 feet above Ordnance Datum), so this is evidently the Marlstone rock-bed (*cf.* Phipp's Well and Lion Brewery), and is on the S. side of the Fault.

WELLS AT THE BREWERY.

26. A 9 foot well was sunk in 1890 to a depth of 29 feet in a part of the river bed filled up.

Top about 192 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
River Gravel	Filled up river bed 6 or 7 feet Gravel	22	0		
Upper Lias.	Clay - - - - - - - - 6 or	7	0	29	0

Water usually attains a rest level 12 feet from the top, and the temperature is 52° F. This, like all the other river gravel waters for this and other breweries near, is used for cooling purposes only.

27. A boring was made near to the last, in the same filled up branch of the Nene, to a depth of 120 feet, but nothing but blue clay was encountered below the Gravel, and no other than gravel water was found. It was thought, at the time, that this was on the Nene fault, but the Weston Street boring does not support this interpretation. The absence (non-detection ?) of any water-bearing rock is peculiar.

28. There is an old 8-foot diam. well inside the Brewery, 18 feet deep, and singularly when the 9-foot well was being made this was not affected, although two or three wells on the opposite side of Bridge Street, and much further away, were drained by the pumping after they had got down 15 or 16 feet.

29. Cattle Market Well of the Northampton Corporation.

From information by Mr. Frank Tomlinson.

Top about 192 feet above Ordnance Datum.

River Gravel.	Superficial matter and Gravel	14 feet.

Just on to the clay (Upper Lias).

Yield of water variable; maximum about 200,000 gallons per day, and this draws it down about 3 inches. Most water comes from the south towards the river. The level to which the water will rise is a little less than the level of the river nearest to the well.

30. Messrs. P. Phipps & Co.'s Brewery Well in Bridge Street.

Communicated by Mr. Beeby Thompson, from information supplied by Mr. T. Phipps, and other sources, and personal observations (see also *Journ. North. Nat. His. Soc.*, Vol. iii., p. 170, Eunson).

Top about 192 feet above Ordnance Datum.

River Gravel.		Alluvium and gravel	27 0	
Middle Lias.	Upper Margaritatus zone.	Clay, with alternating hard beds, one hard bed abounding in specimens of *Protocardium truncatum* Hard, mottled, ferruginous limestone; green matrix with ochreous inclusions. Very fossiliferous, with *water*	30 0 ?	57 0 ?
		Clays	43 0 ?	100 0

The hard mottled rock was easily identified as the basement bed of the upper division of the Middle Lias, and since the Middle Lias beds down to the base of this must be at least 23 feet thick, it proves that the Middle Lias here is nearly complete, only the rock-bed or so being absent; also the water-bearing rock at 135 feet above Ordnance Datum shows that the Marlstone was only just absent. (*Cf.* Weston Street and Lion Brewery.)

Two headings were made to expose the mottled rock, and the water issued from crevices in it. When first made the water shot out of these crevices a considerable distance.

Messrs. Phipps & Co. have also a shallow River Gravel well, for cooling purposes.

OLD LION BREWERY WELLS.

From information supplied by Mr. W. Bird.

At the Old Lion Brewery in Bridge Street, now occupied by the Northampton Brewery Co., adjoining the river on the south side, are two wells, each reported to be 33 feet deep, and one was proved to be 33 feet 6 inches deep, by measurement, the depth of water being 25 feet.

31. A. Well nearest the entrance.

Top about 196 feet above Ordnance Datum.

	Ft.	in.
To water	8	6
Water	25	0
Total	33	6

Water comes from a rock.

32. B. Well further down the yard.

Top about 192 feet above Ordnance Datum.

	Ft.	in.	Ft.	in.
Alluvium and gravel; not much gravel and not much water in it	15	0		
Clay	18	0		
Blue rock yielding water; only just touched			33	0

Evidently the blue rock in these two wells is the Marlstone or Middle Lias rock-bed, or the hard beds just above (at 159 feet above Ordnance Datum).

The water in these two wells was good enough for brewing, and was so used, as well as for cooling-purposes.

33. BORING AT BRIDGE STREET STATION.

Made by the London and N. W. Railway Co., date about 1848.

Bored 650 feet.

Rev. C. H. Hartshorne "A report on the Drainage of the Nene Valley." Tract 8vo, Northampton, 1848. Mr. H. J. Eunson, *Q. Journ. Geol. Soc.* xl. 483. Revised interpretation by Mr. Beeby Thompson.

Height above Ordnance Datum, 191 feet.

Rest level of water, 183 feet above Ordnance Datum.

Salt Water.

	Thickness. Ft.	in.	Depth. Ft.	in.
Superficial accumulation, consisting of detrital gravels, dark tenacious clays with erratic boulders	46	0	46	0
(*River gravel 26 feet? Middle Lias 20 feet? No erratics, but nodular lumps of Middle Lias.*—B. T.)				
Lias blue clay with bands of stone	550	0	596	0
(*Part of the Middle Lias—some 80 feet—and all of the Lower Lias 470 feet?*—B. T.)				
Very hard pyritous rock	1	0	597	0
(*Top of the Rhætic beds. c.f. Gayton, the 15 feet of limestone should probably come here also.*—B. T.)				
Variegated sandstone—red, green, and white, with 15 feet of limestone	46	0		
White sands	3	0	646	0
Magnesian Limestone	4	0	650	0
(*Salt water is said to have come from this at 650 feet, which rose to within 8 feet of the surface; therefore this probably corresponds with the Trias conglomerate of other sections, Gayton, Kettering Road, Kingsthorpe.*)				

34. MESSRS. MANNING AND CO'S BREWERY.

Black Lion Hill.

Well and Boring.

Top about 210 feet above Ordnance Datum.

		Ft.	in.	Ft.	in.
	Marl or ironstone	5	0	5	0
Upper Lias.	Clay with limestone nodules	62	0		
	Rock yielding *water*	1	0	68	0
	Clay with limestone nodules	40	0	108	0
Middle Lias?	Very hard rock with *water*	3	0	111	0
	Clay				

Water first broke in at 67 feet down (143 feet above Ordnance Datum) and came from a hard rock 1 foot thick, which yields about half the total supply. Water rises to within 31 feet of the top if left long enough. The lower water bearing rock (at 102 feet above Ordnance Datum) is probably the marlstone (*Cf.* Messrs. Ratliffe and Jeffery's well).

35. NORTHAMPTON TANNERY CO., ST. JAMES END

Communicated by Mr. Beeby Thompson from information supplied by Mr. Carlton B. Heal, manager.

Well and Boring, (1904); in one of the covered yards.

Top about 198 feet above Ordnance Datum.

Section approximately.

	Ft.	in.	Ft.	in.
Refuse	4	0		
River alluvium	2	0		
River gravel	16	0		
Blue clay	144	0		
Hard rock yielding a little water			166	0

Abandoned because it was thought they were in the Lower Lias.

Considering the low level at which the Northampton Sand is met with over a considerable area hereabouts, and the nearness to one or more faults, it was a pity this boring was abandoned without going another 10 or 12 feet, as it is quite likely that the rock yielding water was the Cephalopoda bed at the top of the Communis beds of the Upper Lias.

Orton.

Geol. map 52 N.W. ; One-inch map N.S. 170 ; Six-inch map 24 S.E.

Made by Mr. J. Fleming, of Newcastle-on-Tyne. Date 1883-84. Bored 789 feet.

Henry John Eunson "The Range of the Palæozoic Rocks beneath Northampton." *Quart. Journ. Geol. Soc.*, Vol. xl., pp. 482-496 ; also Henry John Eunson, "Notes on a Deep Boring at Orton, &c." *Journ. Northampton. Nat. Hist. Soc.* Vol. iv., p. 57.

Arranged by Mr. Beeby Thompson.

Height above Ordnance Datum 374·7.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
	Upper Lias	Surface soil and light brown clay - -	10	0	10	0
		Blue clay—no fossils observed- - -	30	0	40	0
		Clay with many fossils and much comminated shell - - - - - -	8	0	48	0
	Middle Lias 87 ft.	[1]Hard green oolitic rock with fossils and concretions or pebbles - - - -	6	0	54	0
		Blue clay - - - - - - - - -	8	0	62	0
		Shelly clay - - - - - - - -	7	0	69	0
		Clay with thin bands of stone and numerous fossils - - - - - -	21	0	90	0
		Blue clay, micaceous, numerous fucoidal markings - - - - - - -	45	0	135	0
	Lower Lias 531 ft.	Harder, smooth, blue clay with numerous fossils, including *Ammonites capricornus*	48	0	183	0
		Dirty looking micaceous clay with much Iron Pyrites - - - - - - -	15	0	198	0
		Shelly clay - - - - - - - -	9	0	207	0
		Stone with fossils - - - - - -	1	6		
		Blue clay - - - - - - - - -	5	0	213	6
		Stone - - - - - - - - -	5	0		
		Blue clay - - - - - - - - -	105	6	324	0
		Hard shelly clay - - - - - -	7	0	331	0
		Stone with fossils - - - - - -	1	0		
		Hard blue clay - - - - - -	36	0	368	0
		Hard shelly rock - - - - - -	2	0		
		Blue clay - - - - - - - - -	59	0	429	0
		Stone with fossils - - - - - -	1	0		
		Blue clay - - - - - - - - -	12	0		
		Blue clay—softer - - - - - -	52	0	494	0
		Stone, blue, shelly - - - - - -	4	0		
		Blue clay - - - - - - - - -	24	0	522	0
		Indurated clay - - - - - - -	1	0		
		Dark blue clay - - - - - - -	36	8	559	8
		Stone with fossils - - - - - -	1	6		
		Light grey stone - - - - - -	1	8		
		Blue clay - - - - - - - - -	0	6	563	4
		Grey stone - - - - - - - -	0	8		
		Blue clay - - - - - - - - -	102	0	666	0
Rhætic 22 ft.	White Lias 12 ft. 3 in.	Junction bed between Lias clay and limestone below.	0	6		
		White limestone, fissured, containing large crystals of calc-spar, and some iron pyrites.	3	6	670	0
		Conglomerate of small pebbles, some of limestone, cemented by iron pyrites.	0	3		
		White, sandy limestone - - - - -	6	9	677	0
		Conglomerate of small fragments of quartz-porphyrite and some iron pyrites.	1	3	678	3
	Equiv. of Black Shales 9 ft. 9 in.	Green (or grey ?) shale - - - - -	0	6		
		Band of grey sandy marl - - - - -	1	9		
		Green shale with light and dark bands -	7	6	688	0

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[1] It is pretty certain this is not the rock-bed but the one met with some 20 feet below in the neighbourhood of Northampton ; hence the Middle Lias is incomplete at Orton.

Made by Mr. J. Fleming, of Newcastle-on-Tyne. Date 1883-84. Bored 789 feet.
—*continued.*

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Trias 27 ft. 6 in.	Coarse, grey sandstone	24	0		
	Breccia of fragments of quartz-porphyrite or dacite in a green sandy matrix	3	0	715	0
	Old land surface at 340·83 feet below sea-level.				
Archæan.	Quartz-porphyrite or quartz-felsite[2] with eroded surface. Distinct cleavage in the rock at an angle of 18° with the axis of the core.	74	0	789	0

Orton Longueville.

In Huntingdonshire, 2 miles south of Peterborough.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 8 S.E.

Made by Mr. J. E. Noble, Thurlby, near Bourne. 1900.

Communicated by Mr. Henry Preston, F.G.S.

No Water.

		Thickness. Ft.	Depth. Ft.
Old well (no data)	Well	20	20
[Great Oolite Limestone ?]	Rock	5	25
Estuarine Beds Upper Lias	Clay	95	120

It is possible that the "Rock" may belong to the Northampton Sand.

Oundle.

One-inch map N.S. 171 ; Geol. map 64 ; Six-inch map 19 N.W.

Mr. T. Barnes. 1881.

Made and communicated by Messrs. Le Grand and Sutcliff to Mr. Whitaker.

Water level 30½ feet down (July).

		Thickness. Ft.	Depth. Ft.
Dug well (the rest bored ?)			8
Great Oolite Series and Northampton Beds.	Clay and freestone	29	37
	Mottled clay and sand	4	41
	Black sand	5	46

Overstone.

One-inch map N.S. 185 ; Geol. map 52 N.W. ; Six-inch map 38 N.E.

Communicated by Mr. Beeby Thompson.

1. Well a little to the west of OVERSTONE GRANGE.

		Ft.	in.
	Soil [and ? Drift]	11	9
Northampton Sand.	Yellow, sandy, oolitic ironstone Sump in clay ?	29	11
		41	8

Water stands about 10 feet in the well, which is probably a little more than the depth of clay.

2. RECTORY FARM COTTAGES.

Cottages by the road-side a little beyond Overstone Grange on the Kettering road.

	Ft.	in.
Well	39	6 deep.
Rock-Northampton Sand ; reported to be	18	2 thick.
Water stands about	6	0 deep.

See T. G. Bonney, Address to Geol. Soc., *Quart. Journ. Geol. Soc.*, vol. xli, p. 48.

Passenham.

One-inch map N.S. 202 ; Geol. map. 46 N.W. ; Six-inch map 61 S.W.

Communicated by Mr. Beeby Thompson, from information given by Mr. Henry Roberts, Deanshanger.

Various trial wells and borings made in 1903 by Messrs. Law and Harris, for public supply, mostly in Boulder Clay, but no scheme carried out.

Well and boring 300 yards east of NORTHFIELDS FARM, towards Deanshanger.

		About Ft.	in.
	Well.		
Boulder Clay,	Stonebrash (soil with limestone fragments)	1	6
	Stiff clay, a little marly towards bottom and there yields some water	30	0
	Boring.		
	Similar clay to above but darker colour, with chalk. 29 to 30 feet	29	0
	Grey sand with much argillaceous matter ; yields water	1	3
	Rock ? something hard.		

Mr. Henry Roberts, of Deanshanger, says that at that locality you can bore for 130 feet and only get blue clay with chalk stones, and this appears to be the condition in the valley at Passenham, although on the borders of the valley the rocks are quite normal.[1]

Peakirk.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 3 S.W.

7 miles north of PETERBOROUGH.

Made by Mr. J. E. Noble, Thurlby, near Bourne. 1901.

Communicated by Mr. Henry Preston, F.G.S.

Overflows 6,000 gallons per hour.

		Thickness. Ft.	in.	Depth. Ft.	in.
Fen Deposits.	Soil	0	6	0	6
	Gravel	8	6	9	0
Oxford Clay and Kellaways Beds.	Clay	31	4	40	4
	Sand	1	0	41	4
	Hard Grey Sand	7	0	48	4
	Clay	8	6	56	10
Cornbrash.	Rock	8	6	65	4
Great Oolite Clay.	Clay	10	0	75	4
Great Oolite Limestone, 15 ft. 10 ins.	Rock	2	6	77	10
	Clay	2	3	80	1
	Rock	11	1	91	2
Upper Estuarine Series.	Clay	28	6	119	8
Lincolnshire Limestone.	Rock	33	4	153	0

Peterborough.

1. DOGSTHORPE.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 8 N.E.

Made by Mr. J. E. Noble, Thurlby, near Bourne, 1899.

Communicated by Mr. Henry Preston, F.G.S.

Yield—Small supply.

		Ft.	in.	Ft.	in.
Fen Deposits, etc.	Dug Well, strata unrecorded	30	0	30	0
Oxford Clay and Kellaways Beds.	Clay	11	0	41	0
	Sand	5	0	46	0
	Clay	12	6	58	6

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[1] See also paper by F. W. Harmer, *Quart. Journ. Geol. Soc.*, vol. lxiii., p. 495.

1. DOGSTHORPE.—*continued.*

		Ft.	in.	Ft.	in.
Cornbrash, 6 ft. 6 in.	Rock	6	6	65	0
Great Oolite Clay, 13 ft. 6 in.	Clay	6	6	71	6
	Rock		3	72	9
	Clay	5	9	78	6
Great Oolite Limestone, 7 ft. 6 in.	Rock	7	6	86	0
Upper Estuarine Series, 31 ft.	Clay	31	0	117	0
Northampton Sand, 17 ft. 4 in	Grey sand	9	0	126	0
	Black sand	7	0	133	0
	Rock	1	4	134	4
Upper Lias.	Clay	92	8	227	0

Note.—This well was originally tubed into the Lias clay and no water obtained. During August, 1902, the tubes were drawn, and when above the black sand water rose into the well.

2. Boring at NEW ENGLAND for G.N. Railway. 1885.

Communicated by Mr. Beeby Thompson from information supplied by Mr Edwin Wheeler.

		Ft.	in.	Ft.	in
	Made ground and gravel	5	0	5	0
Cornbrash 3 ft.	Hard, light-brown, brashy rock	2	0	—	
	Soft, shaly brown rock	1	0	8	0
Great Oolite Clay, 12 feet.	Dark green clay	7	0	—	
	Greenish limy clay with small ironstone nodules	5	0	20	0
Great Oolite Limestone.	Hard, blue, fissile limestone with bands of clay	10	0	30	0
Upper Estuarine Series, 46 ft.	Green limy clay	17	0	—	
	Black clay	29	0	76	0
Equivalent of Lincolnshire Limestone ? 79 ft.	Light blue, compact nodular limestone	2	6	—	
	Dark-grey, limy clay	76	6	155	0
Equivalent of Northampton Sand and Upper Lias 126 ft. 4 in. ?	Light blue nodular limestone	3	0	—	
	Black limy clay	37	0	—	
	Nodular limestone	1	0	196	0
	Dark coloured clay (*Leda ovum* at 220 ft.)	39	0	235	0
	Limestone	1	6	—	
	Dark clay	5	6	—	
	Limestone with pyrites	2	0	—	
	Dark clay, grey, micaceous (with Falcifer Ammonites)	31	0	—	
	Nodular limestone	1	6	—	
	Clay	3	6	—	
	Hard blue nodular limestone	1	4	281	4
Middle Lias ? 81 ft. 8 in.	Grey clay	78	2	359	6
	Hard, grey, pyritic limestone	1	6	—	
	Hard, blue, shelly limestone	2	0	363	0
Lower Lias.	Dark clay	5	0	—	
	Hard limestone	5	6	—	
	Clay with stone	17	6	—	
	Limestone, bluish and hard, bored, (with *Belemnites Clavatus*)	10	0	—	
	Hard rock, with fossils, resembles the Jamesoni beds of Western Northamptonshire	20	0	—	
	Clay	7	0	428	0

3. Old Boring at NEW ENGLAND.

		Thickness. Ft.	Depth. Ft.
	Soil	2	2
Cornbrash.	Rock	4	6
Great Oolite Clay.	Blue clay	11	17
Great Oolite Limestone.	Marl	3	20
	Dry silt	4	24
	Wet silt	2	26
Estuarine Beds and Upper Lias.	Blue clay	40	66
	Shale	3	69
	Blue clay	100	169

From "The Geology of Peterborough and its Vicinity" by H. Porter, M.D., F.G.S. 1861.

Dr. Porter remarked that he was "unable (not having seen the boring) to determine the strata."

It is not improbable that the materials were pounded up and that the Great Oolite Limestone may be represented by the Marl and Silts, which were brought up in the form of sludge.

The above grouping does not coincide with that given in the previous record, but the assignment of 76½ feet of clay as equivalent of Lincolnshire Limestone is given doubtfully by Mr. Beeby Thompson. H.B.W.

4. Boring at NEW ENGLAND, near Peterborough.

Made by Mr. J. E. Noble, Thurlby, near Bourne. 1897.

Communicated by Mr. Henry Preston, F.G.S.

No water.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	0	1	0
Cornbrash.	Rock	5	10	6	10
Great Oolite Clay.	Clay	11	0	17	10
Great Oolite Limestone.	Rock	2	3	20	1
	Clay	1	0	21	1
	Rock	7	3	28	4
Upper and Lower Estuarine Series. Upper Lias Clay	Clay	131	8	160	0

5. Well at GASWORKS.

Recorded by Prof. H. G. Seeley, *Quart. Journ. Geol. Soc.*, xlv., p. 391.

		Thickness Ft.
[Oxford Clay and Kellaways Beds.]	Blue clay	24
	Fine grey sand	12
	Clay	—

Piddington.

One-inch map N.S. 202; Geol. map 52 S.W.; Six-inch map 52 S.E.

Communicated by Mr. Beeby Thompson. Section compiled from particulars supplied by Mr. James (occupier), and by Mr. Smart (contractor) and personal observation. 1906.

Well at PIDDINGTON GRANGE.

Top about 362 feet above Ordnance Datum.

			Ft.
Boulder Clay.		Good typical chalky boulder clay, with large scratched boulders and fossils ranging from the Lower Lias to the Oxford clay	70
Upper Estuarine?		Dark blue clay free from stones	12
	Upper Estuarine Limestone?	Hard limestone rock with *Rhynchonellæ*, &c., scarcely seemed a continous bed	2
		Dirty looking grey or brown clay. Sandy white bits in it not so big as peas (Mr. Smart). Pebbles and stones all the way down but scarce (Mr. James).	8

Well at PIDDINGTON GRANGE.—*continued.*

		Ft.
Lower Estuarine ?	Sand. White loamy sand (Mr. Smart). Black silvery sandy (Mr. James). With water	1
		93

The last bed was a quicksand and yielded much water. It buried the pump, and the men almost sank into it. For various reasons the classification of beds given must be regarded as provisional : the entire thickness might be Drift.

Preston Deanery.

One-inch map N.S. 202; Geol. map 52 S.W. ; Six-inch map 52 N.W. ; 52 N.E.

Communicated by Mr. Beeby Thompson.

1. VILLAGE

The wells here are quite shallow, and derive their water from a sand bed (Preglacial sand ?) under about "a yard of other stuff."

2. THE ROOKERY.

Well in stable yard. Top about 292 feet above Ordnance Datum.

	Ft.	in.
To water	7	7
Water	20	2
	27	9

3. WINDMILL WELL.

Communicated to Mr. Beeby Thompson by Mr. W. Smart.

Top about 280 feet above Ordnance Datum.

		Ft.
Boulder Clay and sands.	Clay and loam	8 ?
	Gravel and sand ; more sand than gravel, "running stuff"	4 ?
	Gravel one side and clay with flints the other—very awkward to work because the curb sank unequally	10 ?
Upper Lias ?	Blue clay—no stones	13
		35

Not much water—supplemented by other means.

Pytchley.

One-inch map N.S. 186 ; Geol. map 52 N.W. ; Six-inch map 32 N.W.

Communicated by Mr. Beeby Thompson.

Well on high ground about ½ mile west of Pytchley, for a public water-supply. 1901.

		Ft.
Boulder Clay.	Light coloured chalky clay	12
	Light blue clay	5½
	Sand	1
	Dark blue chalky clay	22½
Glacial Gravel.	Limestone gravel — Great Oolite material essentially, yielded *water* at rate of 35 gallons per hour	1
Upper Estuarine.	White marl with vertical black streaks	4
	Black shale with carbonaceous matter in horizontal layers	1
	Hard, light grey, subcrystalline, shelly limestone (Estuarine limestone)	4
	Clay	7
		58

Water comes from the Estuarine limestone and rises 10 feet above it. Yield about 12,000 gallons per day.

Raunds.

One-inch map N.S. 186 ; Geol. map 52 N.W. ; Six-inch map 33 S.E.

Communicated by Mr. Beeby Thompson.

Hitherto Raunds has been supplied with water from numerous wells, over 30, some very shallow or merely springs with a small supply, others are as much as 50 feet deep. The chief source of the water is the Northampton Sand, but other beds supply or contribute, as will be observed in the record of wells.

1. Well at the OLD LIMESTONE QUARRY (Mr. Fisher's) W. of Raunds.

Top about 204 feet above Ordnance Datum.

		Thickness. Ft.
Great Oolite.	Rubble	10
	White Stone	10
Northampton Sand.	Ironstone	10
	Bluish oolitic stone, very hard to get	4
Upper Lias.	Clay	2
		36

2. MR. KINGSMITH'S WELL. W.S.W. in village.

Top about 159 feet above Ordnance Datum.

		Ft.
Great Oolite Limestone.	Limestone	15
Northampton Sand.	Red rock	4

Water stands 2 feet in the well. Yield on one occasion when tested about 30,000 gallons per day.

3. Well, Mr. Harold Nichols' NEW HOUSE, S.W. of Raunds.

From information supplied by Mr. Smith, builder, and personal observation.

		Ft.	in.	Ft.	in.
	Cornbrash—yellowish stone	3	6 ?	3	6 ?
Great Oolite	Great Oolite clay, purple and greenish	10	0 ?	13	6 ?
	Great Oolite limestone and Upper Estuarine beds	24	0 ?	37	6 ?
Northampton Beds, 15 ft. 2 in.	Lower Estuarine beds	8	0 ?		
	Dark green stone	4	8		
	Hard pyritous stone in various courses, about 6 in. thick	2	0		
	Ironstone, etc., and pebbles	0	6	52	8
Upper Lias.	Blue clay	0	3		
	Hard Lias rock cement stone	0	9	53	8

Water flows through the well at base of the Northampton Sand towards the brook.

4. Well at BRICKWORKS, north of Town.

Made in 1884. Water rises to within 2 ft. of surface (186 ft. above Ordnance Datum).

Top about 188 ft. above Ordnance Datum.

Probable section. Two accounts differ materially.

	Ft.
Oxford clay, including Kellaways clay and Kellaways rock. Water obtained from a slaty rock with Belemnites	30
Cornbrash and other rocks below, to the Upper Lias? Water from the Northampton sand	48
	78

It seems more probable that the first water would come from the cornbrash, but this would scarcely be a slaty rock under 30 feet of the rocks.

5. Well. N.E. Corner of VILLAGE.

Top about 183 ft. Ordnance Datum.

	Ft.
Cornbrash ?	3
Beds below to the Upper Lias	? 44
	47

The discrepancy of levels in the wells is accounted for by a fault which is known to exist.

6. WELL. MR. SMITH'S BRICKWORKS, in field to the E. of Raunds.

Beeby Thompson, *Journ. Northampton Nat. Hist. Soc.* Vol. xi. pp. 236–7.

	Ft.
Kellaways Clay	8
Cornbrash (reported 5 feet)	4 ?
Great Oolite clay, variegated	10
Great Oolite limestone, mostly a greenish rock Upper Estuarine beds, marly clay with oysters, etc.	18½
Lower Estuarine beds, hard sandy material with numerous plant markings	8
Ironstone beds, very hard, much iron pyrites	5
Line of small black pebbles (phosphatized), much iron pyrites in good crystals 1 in. to 3 ins. Upper Lias clay, blue	3
	56½

7. PASTURE LODGE, about 1 mile S.E. of Raunds.

Information from Mr. Smith, builder.

Well Top about 246 feet above Ordnance Datum.

		Ft.
Oxford Clay and Kellaways Beds.	Clay	81
Cornbrash ?	Rock	?

As soon as the rock was pierced, water rose 17 feet and stopped further sinking. The water was quite unusable. On one occasion the writer had some water pumped up; the first bucketful was clear and odourless, the second was getting thick and reddish, but there was no odour; afterwards the water had the odour of sewage. Sulphuretted hydrogen was present, being due, no doubt, to the decomposition of iron pyrites.

8. TRIAL WELL, near Meadows Road, to the W. of Raunds, and about 700 yards from the river.

From information supplied by Mr. Thomas Yorke, Surveyor; and personal observation of specimens.

Top 116 feet above Ordnance Datum.

				Ft.	in.	Ft.	in.
	River deposits.	Loamy clay		4	0	4	0
		Gravel yielding a large supply of water		12	0	16	0
Upper Lias.		Blue clay		88	0	104	0
	Communis beds.	Argillaceous limestone		2	0		
		Highly fossiliferous hard clay		3	6	109	0
	Serpentinus beds.	Oolitic rock		1	6		
		Dark blue indurated clay		4	6	115	6
		Rock crowded with ammonites of the falcifer group	one block of stone.	3	6		
Middle Lias.	Rock-bed.	Argillo-calcareous rock, grey or brown, with rounded pebbles and small dark green granules. *Pecten æquivalvis*		—		119	0
		Clay		3	0		
		Limestone nodules		0	6		
		Clay		1	0		
		Thin band of limestone		0	1		
		Clay		2	6	126	1
		Calcareous rock full of pebbles or concretions, and shells, &c.		0	6		
		Clay with rather large argillo-calcareous nodules		4	9	131	4
		Light blue clay		11	0	142	4

The gravel water estimated at 18,000 gallons per hour was stopped out in order to continue sinking.

Water was again encountered at 100 feet, equal to about 120 gallons per hour, which rose 82 feet, and this increased to over 600 gallons per hour when the argillaceous limestone met with at 104 feet was pierced, and it rose and flowed over the top of the well in about two days, but was very brackish (*see* analysis).

Water was again tapped in the Rock-bed, and it was not so highly charged with saline matter as the water from the "Communis" beds, but the yield was not great, about 1,500 gallons per hour (25,000 gallons per day), and no material increase was obtained by going deeper.

At this stage the well was considered a failure so far as a Middle Lias supply of water was concerned. (1906).

The Local Government Board was then requested to allow the Urban Council to use the gravel water, and after investigation the request was granted.

Ravensthorpe.

1. In VALLEY about three-quarters mile E.N.E. of CHURCH.
Geol. map 53 N.E.; One-inch map N.S. 185; Six-inch map 37 N.W.
Made by Mr. Frank Tomlinson, Engineer. Date, 1907.
Communicated by the Local Government Board.
Height above Ordnance Datum, 320 feet. Rest level of water, 242·7 feet above Ordnance Datum.
Yield 291,000 gallons per diem.

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Valley deposits.	Made ground; small, loose, dry material	4	0	4	0
	Black, wet material, with wood and gravel (old river-bed)	9	6	13	6
Upper Lias.	Clay	45	11	59	5
	Hard blue rock	1	0	60	5
	Blackish clay with calcareous grains	2	8	63	1
	Hard blue rock with calcareous grains	0	7	63	8
	Blue clay	2	6	66	2
	Fine-grained hard blue rock	0	8	66	10
Middle Lias.	Very hard grey rock with crystalline bands	4	0	70	10
	Hard blue clay	8	8	79	6
	Sandy friable rock	0	3	79	9
	Very hard crystalline rock	1	6	81	3
	Dark hard micaceous clay	5	9	87	0

The wells at Ravensthorpe derive their water from the Northampton Sand at variable but moderate depths. Of these the following particulars are communicated by Mr. Beeby Thompson.

2. WELLS at the EASTERN END of the VILLAGE are from 14 to 18 feet in depth, and the water stands 2 or 3 feet in them. (1895.)
3. A WELL on the NORTHERN STREET (road to Guilsborough) was 15 feet to the bottom, and it was said that the water overflowed in wet weather. Now closed?
4. A WELL in a GARDEN further down the slope to the north was 8 feet 6 inches deep, including 5 feet of water, and this is said to run dry in summer.
5. A WELL at the JUNCTION of ROADS, southern entrance to the village, is about 11 feet deep.

6. CHORLEY COP.
About five-sixth's mile W. of Ravensthorpe.

At Chorley Cop (Clarke's Farm) the well is 90 feet deep according to Mr. Gilbert, well sinker, of West Haddon (1895).

7. TRIAL WELL AT RAVENSTHORPE RESERVOIR.
Communicated by Mr. Beeby Thompson from information supplied by Mr. F. Tomlinson, and personal observation.
Top 329·3 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
		1. Red earth, washing down of ironstone	8	0	8	0
Upper Lias.		2. Blue clay, few fossils	52	0	60	0
	Communis Beds.	3. Cephalopoda-bed. A clay gradually passing into hard rock, crowded with ammonites. Lowest layer a blue rock without fossils, 6 inches	3	0		
		4. Clay, oolitic, full of fossils	1	3		
		Band of hard rock similar to Cephalopoda-bed above	0	4		
		Softish clay	0	5	65	0
	Serpentinus Beds.	5. Hard, close-grained rock, no fossils	1	0		
		6. Very hard clay	1	6		
		7. Very hard grey rock with large ammonites of the falcifer group	0	7	68	1

7. TRIAL WELL AT RAVENSTHORPE RESERVOIR.—*continued.*

Top 329·3 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
Middle Lias.	Rock-bed possibly.	8. Very hard crystalline rock, full of fossils not to be identified. May be rock-bed but nothing to identify it - - - - - - - Irregular friable rock consisting of comminated shells, 1 inch - -	1	9	69	10
		9. Hard, grey, micaceous rock, finely laminated, much like fish-bed, and apparently some fish teeth in it -	0	2	70	0
		Forms roof of tunnel for some 200 feet at north-eastern side.				
		10. Hard rock, full of fossils, crowded with *Protocardium truncatum* and containing *Ammonites margaritatus*	2	0	72	0
		Forms roof of adit where not too much broken up.				
		11. Fine hard clay of the adit - - -	8	6	80	6
		12. Friable rock, practically all comminuted shell for 3 inches above next and mostly so all the thickness - Fossiliferous rock, much comminuted shell, numerous well-rounded nodules, almost a conglomerate - Floor of the Heading. This yields the water - - - - - -	2	4	82	10
		13. Dark, fine-grained, micaceous clay -	10	0	92	10

Compare with next below.

8. ENGINE HOUSE WELL, RAVENSTHORPE RESERVOIR.

(Same as No. 1.)

			Ft.	in.	Ft.	in.
		1. Made up ground, burnt ballast - -	4	0	4	0
		Black material—wood, gravel, &c. Bog matter - - - - -	9	6¾	13	6¾
Upper Lias.		2. Blue clay—few fossils - - - -	45	10¼	59	5
	Communis Beds.	3. Cephalopoda-bed. Hard bed with numerous ammonites - -	1	0		
		4. Blackish clay with oolitic concretions -	2	8	63	1
	Serpentinus Beds.	5. Hard rock with oolitic concretions -	0	7		
		6. Clay - - - - - - - - -	2	6	66	2
		7. Fine grained, hard, blue rock, 8 in. - Soft clay separating 7 and 8, 1 in. to 3 ins. - - - - - -	4	8	70	10
Middle Lias.	Rock-bed?	8. Hard grey rock, 3 ft. 9 in. ? - Beds 7 & 8 form essentially one rock. The lower part forms the roof of the Heading at this end.				
		9. 10. Not recognised at this end of the Heading.				
		11. Clay of the Heading - - - - -	8	8	79	6
		12. Fine friable rock, 3 in. - - Fossiliferous rock with rounded nodules, &c. - - - - -	1	9	81	3
		13. Hard blue clay - - - - - -	6	9	88	0

The first well was made some 500 feet from the embankment of the reservoir, the second one in the engine house, and the two were connected by a heading.

Yield of water very large at one time, as much as 800,000 gallons per day, but declined to about 300,000 with exhaustive pumping during excavation of the long heading connecting the two wells.

Rothersthorpe.

One-inch map N.S. 202 ; Geol. map 53 S.E. ; Six-inch map 51 N.E.
Communicated by Mr. Beeby Thompson, from information supplied by Mr. F. W. Millner.
Well near to No. 1 Lock, Grand Junction Canal.
Top about 294 feet above Ordnance Datum.

		Ft.	in.
Boulder Clay.	Soil and clay - - - - - - -	7	0
Glacial Sand.	Sand - - - - - - - - - -	33	0
Base of Upper Lias and top of Middle Lias.	Stone, marl and clay - - - - -	7	6
	Blue clay - - - - - - - -	0	6
		48	0

The Stone beds include the Fish-bed, Paper-shales, and Marlstone rock-bed. Water stands 8 feet in the well.

Rushden.

One-inch map N.S. 186 ; Geol. Map 52 N.W. ; Six-inch map 40 S.W.
1. Trial Well on the Bedford Road.
Communicated by Mr. W. B. Madin to Mr. Beeby Thompson.
311·27 feet above Ordnance Datum. Water-level 215·98 above Ordnance Datum.

		Thickness. Ft.	Depth. Ft.
Boulder Clay	Clay with chalk - - - - -	16	16
Oxford Clay.	Blue clay - - - - - - -	45	61
Cornbrash. 5 feet.	Stone - - - - - - - -	3	64
	Grey rock - - - - - - -	2	66
Great Oolite Clay.	Blue clay - - - - - - -	10	76
Great Oolite Limestone. 13½ feet.	Grey rock - - - - - - -	3	79
	Blue clay - - - - - - -	0½	79½
	Grey rock - - - - - - -	2¾	82¼
	Blue rock - - - - - - -	3	85¼
	Blue shale - - - - - - -	0½	85¾
	Grey-brown rock - - - - -	2	87¾
	Blue-grey rock - - - - - -	1¾	89½
Upper Estuarine Beds.	Blue-grey shale (original water level)	4½	94
	Blue-grey rock (Estuarine Limestone ?)	5	99
	Oolite clay - - - - - -	3	102
Northampton Sand.	Blue-grey rock, fissured - - -	3	105
Upper Lias.	Blue clay - - - - - - -	6½	111½

Headings were driven North and South between the levels 99 and 104 feet.

The following notes were communicated by Mr. R. E. Middleton to Mr. Whitaker, 1890 :—

Foul air said to be met with 61 feet down.

Water was met with at depths of 95 and 102 feet and appeared to flow from S.S.E. Quantity appeared to fluctuate ; thus on September 25th the yield was reported to be 700 gallons, on September 17th to be 1,100, and on October 7th to be 550 gallons per hour ; but some fluctuations may be due to inaccurate gauging.

N.B.—The shaft (bricked) stands close to infectious hospital, built, however, after well was made. A. C. G. C.

Rushden is now supplied with water from a reservoir south-east of Sywell.

2. Trial Well and Boring near Knuston Spinney.
Communicated by Mr. W. Whitaker.
Shaft 58 feet, the rest bored. About 280 feet above Ordnance Datum.
No Water.

	Thickness. Ft.
Chalky Boulder Clay - - - - - - - -	104
,, ,, ,, mixed with sand and gravel ; Boulder just below 113 feet - - - - - -	12
Lias clay - - - - - - - - - -	1½
	117½

3. KNUSTON HALL.

	Ft.
Great Oolite Limestone Clay (?)	35
Upper Lias	

4. KNUSTON LODGE.

	Ft.
Boulder Clay	30
Great Oolite Limestone	
	65

A. C. G. C.

Stanion.

One-inch map N.S. 171 ; Geol. map 64. ; Six-inch map 17 N.E.

Communicated by Mr. Beeby Thompson.

1. Well at the extreme north of the village, on the site of the new reservoir.

From information supplied by the workmen and by the District Council Surveyor ; and partly personal observation. Record not very accurately taken.

Top, 307 feet above Ordnance Datum.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Drift.		Soil	2	0		
		Boulder clay—yellowish	5	0	7	0
Lincolnshire Oolite.		Limestone rock	7	0	14	0
		Running sand	0	9		
		Sand, red, brown, and light-coloured	5	3	20	0
Northampton Beds 25 ft. 6 ins.?	Lower Estuarine.	Blue clay with carbonaceous markings	2	0		
		White and red sand	3	6	25	6
		Dark carbonaceous clay	5	0	30	6
		White and red sand	4	0	34	6
		Ironstone	11	0	45	6
Upper Lias		Clay	10	0	55	6

Water came from all parts of the Lincolnshire Oolite beds as the well was deepened ; finally at rate of about 1,500 gallons per day. A much larger amount came from the Northampton Sand at first, but this source entirely failed after a time, and the well was abandoned for a new source.

2. A shallow well in the same field, at a lower level, gives water from the sand beds of the Lincolnshire Oolite ; and a spring still lower down is from the same source. These on the western side of the road.

3. On the eastern (and northern) side of the main road three wells have yielded water at a slightly lower level (2 or 3 feet) than those on the western side, and a spring supplies the Manor Farm pond at just about the same level. All apparently derive water from the same source—the sand beds at the base of the Lincolnshire Oolite.

4. Well near to "Lord Nelson" Inn.

Top, about 270 feet above Ordnance Datum.

	Ft.
To water	27
Water	1
	28

Northampton Sand source, within 4 or 5 feet of the top.

5. Mr. Singlehurst's Well a little north of the Church, on opposite side of road to Church. Top, about 266 feet above Ordnance Datum.

	Ft.
To water	16
Water	2
	18

Northampton Sand source. North side of a Fault.
(Six-inch map 17 S.E.)

6. Post Office well, a little below Mr. Singlehurst's. Top, 263 feet above Ordnance Datum.

	Ft.
To water	32
Water	6½
	38½

Northampton Sand source. South side of a Fault.

7. Mr. Carruthers' well, at bend of road, south of the church. Top, 253 feet above Ordnance Datum.

			Ft.	in.
Northampton beds.	Lower Estuarine mostly.	Red and purple clays &c. to rock	22	0
	Ironstone beds.	Red rock seen in well	6	10
		Water	3	0
			31	10

8. Mr. Hector's well, beyond the stream, Oakley Road. Top, about 238 feet above Ordnance Datum.

	Ft.
To water	15
Water	9
	24

Lincolnshire Oolite source; therefore must be another "fault" between this and No. 7.

9. "Witches Well." "Old Nan Gulpin's Well."

A shallow well by side of footpath in lane leading to stream to south of Stanion. Top, 226 feet above Ordnance Datum.

Very shallow—a few feet only to the water. Northampton Sand source.

10. New Well for Public Water Supply, near to STANION MILL. Top about 216 feet above Ordnance Datum.

	Ft.
Lincolnshire limestone	7
Northampton sand (not bottomed)	2
	9

This is a remarkable well. It was made within about 30 yards of a spring yielding 24,000 gallons per day, but itself yields 400,000 gallons per day without apparently diminishing the spring near to. It evidently taps the reservoir of which the spring is one of the overflows.

The contact of Lincolnshire Limestone and the Ironstone beds of the Northampton Sand, in the valley and towards the Harper brook, can be observed in other parts of Stanion; but this is peculiar since the absent Lower Estuarine Beds are thick in the neighbourhood (*cf.* well No. 1.) The district is much faulted.

Teeton.

One-inch map N.S. 185; Geol. map 53 N.E.; Six-inch map 30 S.W.

Communicated by Mr. Beeby Thompson.

1. About ¼ mile from TEETON along the GUILSBOROUGH ROAD, east side. Well. Top about 457 feet above Ordnance Datum.

		Ft.
	Boulder clay (a little)	16
Northampton Sand.	Red rock	
Upper Lias.	Blue clay	11½
		27½

A boring was made much deeper.

A little water was found at the junction of red rock and blue clay, but gave out in dry weather. The well was abandoned.

2. Just beyond Teeton on the Creaton Road.

A well to a cottage is said to be 60 feet deep, got on to clay in less than 20 feet, through red sandy beds, but only surface water is collected.

3. Well for General Supply Purposes just beyond Teeton on the Creaton Road.

At a rather lower level than No. 2, but in the same field, a well was made to intercept a spring flowing away at the farm buildings near.

The Section was :—

		Ft.	in.
Northampton Sand.	Red sandstone	10	0
Mixed: Northampton Sand and Upper Lias.	Sandy clay—" slush " passing into blue clay	11	3
		21	3

The chief interest attaching to these wells is that although the Northampton Sand at No. 1 and No. 3 is approximately the same thickness, the surface level of No. 3 well is 66 feet below that of No. 1. This phenomenon is due to slipping on the hillside.

Tiffield.

One-inch map N.S. 202 ; Geol. map 53 S.E. ; Six-inch map 51 S.E.

Communicated by Mr. Beeby Thompson.

Around Tiffield Reformatory, on the road Blisworth to Towcester, are three wells drawing their supply of water from the Great Oolite limestone.

1. In the yard of the Reformatory a well is about 30 feet deep, and it is said by the sinker that only limestone was encountered.
2. A well in a field on the Eastern side of the road is also reported to be 30 feet deep.
3. A well just at the corner of the road to Tiffield, where the old Toll-gate was, is said to be 15 feet deep.

Towcester.

One-inch map N.S. 202 ; Geol. map 53 S.E. ; Six-inch map 56 N.W.

Communicated by Mr. Beeby Thompson.

Towcester has had a public water supply for some years, in part from Dockle Mill spring. The source of water has been some " Drift " gravels at a fairly high level rather more than a mile south-south-east of the centre of the town, but various deep wells or borings (probably a dozen) deriving their water from the Marlstone were also used. The Gravel springs not being adequate, a public Marlstone supply was installed in 1901

1. Fountain Well, High Street.

Top 290 feet above Ordnance Datum.

Boring through Upper Lias Clay to the Marlstone 103 feet deep. Water overflows at the surface.

2. House in High Street, near Town Hall.

Top 290 feet above Ordnance Datum.

Well. Water found precisely as at Fountain Well. Water overflows.

3. The Brewery.

Top about 282 feet above Ordnance Datum.

Well 22 feet ; boring 81 feet. Total 103 feet. Water overflows in great quantity.

A second well and boring was carried to a depth of 50 feet, according to a communication made by Messrs. P. Phipps & Co. to Mr. A. C. G. Cameron in 1898.

4. WATER WORKS. 1899.

Trial boring, 1¼ miles S.W. of the Town, on the Silverstone road.

Communicated to Mr. A. C. G. Cameron by Mr. John Chadwick, of Bletchley.

Top about 303 feet above Ordnance Datum.

			Thickness. Ft.	in.	Depth. Ft.	in.
Drift.		Gravel	8	0	8	0
Upper Lias 119 feet.		Clay	80	0	88	0
		"Bind"	1	0	89	0
		Soft clay	2	0	91	0
		Hard rock	0	6	91	6
		Soft clay	2	6	94	0
		Hard rock	3	0	97	0
		Bind and clay in beds	30	0	127	0
Middle and Lower Lias.	Rock Bed.	Very hard stone [a little water]	3	0	130	0
		Blue clay	136	0	266	0
		Very hard stone in flakes	4	0	270	0
		Blue clay	30 48	0 0	300 348	0 0
		Stone	0	6	348	6
		Blue clay	0	6	349	0
		Rock [a little water]	4	0	353	0
		Blue clay	2	0	355	0

Water was obtained at 126 feet from the surface, which is about 3 feet lower than at Towcester itself, and rose to within 30 feet of the surface, which is not so high as at Towcester by 6 or 8 feet. The quantity, 5,000 gallons per day, being inadequate, the boring was abandoned.

5. BORING for PUBLIC WATER SUPPLY (1901).

In field adjacent to the railway, on southern side of the railway and western side of the main road.

Communicated to Mr. Beeby Thompson by Mr. J. B. Williams.

Top 285·5 feet above Ordnance Datum.

			Thickness. Ft.	in.	Depth. Ft.	in.
Recent Deposits.		Soil	0	6		
		Boulder clay ?	2	0		
		River silt	2	6		
		River gravel	4	9	9	9
Upper Lias.		Blue clay	66	9	76	6
	Communis Beds.	Hard rock	2	0		
		Blue clay	2	6	81	0
	Serpentinus Beds.	Hard rock	1	0		
		Blue clay	2	6	84	6
Middle Lias.		Hard rock with *water*	6	0	90	6
		Rock with bands of clay and sand.	11	6	102	0

Water first found at 78 feet 6 in.

Water rises 7 feet above the surface [at rate of 1,200 gallons per hour].

6. Well at ELM LODGE on the Watling Street, E.N.E. of Towcester.

Communicated by Mr. Thompson.

Top about 332 feet above Ordnance Datum.

Sunk 130 feet.

At 112 feet a rock passed through, and rocks 18 feet further.
Punched through a rock at about 135 feet (197 feet above Ordnance Datum).
Water stands 30 feet from the top (302 feet above Ordnance Datum). Evidently a Marlstone supply.

Upper Heyford.

One-inch map N.S. 185; Geol. map 53 S.E.; Six-inch map 44 S.W.

Communicated by Mr. Beeby Thompson.

The wells in Upper Heyford are supplied with water from two or three sources. Some on the road leading to Nether Heyford only about 30 feet deep appear to be supplied (in part at least) by a sand-bed reported to be 9 to 10 feet thick. Others from 40 to 48 feet deep, derive water from one of the hard beds of the Middle Lias. One reported to be 83 feet deep (found to be 73 feet in 1906) often fills right up, so that it can be little more than a sump. The Marlstone rock-bed is not encountered in the village.

1. Well on Glassthorpe Hill.

From information communicated by Mr. J. Bond, 1905, and personal observation.

Top about 347 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
		Blue clay - - - - - -	51	6	51	6
Upper Lias.	Communis Beds.	Cephalopod bed—*water* came from this and rose 2 or 3 feet but was lost again below - - -	0	9	52	3
		Clay - - - - - - - -	3	0	55	3
	Serpentinus Beds.	Cephalopod bed - - - - -	0	6	55	9
		Clay - - - - - - -	3	6	59	3
		Fish bed and Paper Shales - -	0	6	59	9
Middle Lias.		Transition-bed - - - - - Rock-bed. with *water* - - -	1	0	60	9
		Marl - - - - - - -	2	6	63	3

2. Well at Upper Heyford Lodge.

Section communicated by Mr. Boyes.

Top about 256 feet above Ordnance Datum.

		Ft.
Middle Lias.	Blue clay - - - - - - -	10
	Blue rock - - - - - - -	½
	Blue clay - - - - - - -	11
	Rock yielding *water* - - - - -	—
		21½

Plenty of water, which rises 17 feet in the well. Obviously from one of the lower water-bearing beds of the Middle Lias.

Upton.

Berry Wood Asylum.

One-inch map N.S. 185; Geol. map 53 S.E.; Six-inch map 44 N.E.

Communicated by Mr. Beeby Thompson.

See also *Journ. of Northampton. Nat. Hist. Soc.* Vol. i., pp. 225 and 289; vol. iii., pp. 6 and 7, Vol. xi., pp. 93–105.

When it was proposed to buy the Berry Wood Estate whereon to build the projected County Lunatic Asylum, Mr. Samuel Sharp, F.G.S., F.S.A., was consulted on the possible water supply. There was already (that is previous to 1872) a well on the site, that had been sunk by the owner, Mr. Phillips, to a depth of106 feet, and yielded water from the ironstone beds of the Northampton Sand. After pumping out and cleaning this well its water was tested by the Analyst of the Pollution of Rivers Commission and found to be perfectly satisfactory. Subsequently a boring was made from the bottom of this well about 200 ft., penetrating two or three feet into the Marlstone, but no use was made of it (*J. N. Nat. Hist. Soc.*, Vol. i., p. 289). We will call this Well and Boring No. 1. For the well only the description is the well-sinker's.

No. 1 Well and Boring. Site of Laundry.

Top about 390 feet above Ordnance Datum.

	Well.	Ft.	Ft.
Boulder Clay ? and some UpperEstuarine ?	Clay - - - - - - - about	20	20
Northampton Sand 89 feet.	Sand - - - - - - - - - -	50	—
	Sandstone like that in the quarries at New Duston, then blue stone like that found at the bottom of the ironstone pits but of a greasy nature, 30 to 36 feet - -	36	106
	Boring.		
	Blue greasy stone - - - - - - -	3	109
Upper Lias 190 feet.	Clay - - - - - - - - - -	190	299
Marlstone rock-bed.	Hard bluish stone - - - - - - -	3	302

A drawing of this same well and boring, made by Mr. Lovatt, clerk of the works, gave—

	Ft.	Ft.
Well - - - - - - - - -	109	109
(with water standing 4 feet)		
Boring.		
Green rock - - - - - - - -	4	113
Clay - - - - - - - - -	178	291
Rock - - - - - - - - -	2	293

Subsequent works tend to show that the first account is the more accurate.

No. 2 Well. The Engine House Well (sunk 1872).

Top 390 feet above Ordnance Datum.

To base of ironstone - - -	98 feet.
Total depth - - - - -	102½ ,,

It was recommended, by Mr. Sharp, to sink this second well about 40 feet from the old well (No. 1), to connect the two wells by a heading, and to drive out other headings in radiating directions from the new well, but this was not carried out fully.

Subsequently the old No. 1 Well was filled up and a third well made 273 feet from the second.

No. 3 Well—(sunk 1876).

Top 397 feet above Ordnance Datum.

To base of ironstone - - -	105½ feet.
Total depth - - - - -	110½ ,,

Nos. 2 and 3 were connected by a heading, or rather one of the headings from this well intercepted one of the headings from No. 2 Well, which raised the total length of headings to more than 300 feet, and for a time a sufficient amount of water was obtained.

From 1888 to 1892 Mr. George Bohn, M. Inst. C.E., of Hull, acted as adviser to the Asylum authorities on water-supply matters, and certain works were carried out under his direction in 1891, including the deepening of the junction-heading between the two wells.

No. 4 Well and Boring.

The water-supply from the Northampton Sand temporarily increased by headings, &c., continued to decrease, and in 1892 another site was selected by a Water Diviner, and a shaft was sunk to about the junction between the Northampton Sand and the Upper Lias Clay, but it did not yield any water, although headings were driven in two directions at a depth of 70 feet. A boring was then made from the bottom of this well to a total depth of 250 feet (or more) without finding any water whatever.[1]

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[1] *See* "The Divining Rod, with Critical Remarks on its Use in Northamptonshire and Neighbourhood" by Beeby Thompson, F.C.S., F.G.S., *Journ. Northampton. Nat. Hist. Soc.*, Vol. x., p. 105, 1898; also *Proc. Soc. for Psychic Research*, Vol. xiii., 1897.

No. 4 Well and Boring.—*continued.*

When the boring had reached a depth of about 250 feet the writer was called in (April, 1893) and advised boring to a further depth not exceeding 50 feet, and when 281 feet had been reached he reported that water had been found (June, 1893), but advised making a new well all in the dry rather than deepen the existing one in contention with the water for a considerable depth.

The account available with regard to this well and boring is as follows :—

	Ft.
Bottom of well	63 ?
do. of Ironstone	66
do. of lining tubes of boring	153
Apparent water-level May 17th, 1893	170
Rock 6 in. to 8 in. thick	236
do. 2 ft. to 3ft. thick	239
do. 2 ft. 6 in. thick	251
Bottom of rock 2 ft. to 3 ft. thick	281½
Clay.	

No. 5 Well.[2]

This well was commenced about 12 yards eastward of Well and Boring No. 4, in October, 1893, and below is the section.

Top, about 362 feet above Ordnance Datum.

			Ft.	in.	Ft.	in.
Glacial Drift.		Clay and gravel with some large boulders	10	0	10	0
Lower Estuarine and Ironstone Series of the Northampton Sand.		Red sand and soft red sandstone	59	0	69	0
		Green Oolitic rock	6	0		
		Grey ironstone with red joints and many small phosphatic nodules	3	0	78	0
Upper Lias 183 feet		Blue Clay	172	0		
	Communis Beds.	Cephalopoda-bed — hard calcareous shale, oolitic in places	1	0		
		Clay containing many small calcareous concretions	3	9		
	Serpentinus Beds.	Cephalopoda-bed—hard argillaceous limestone	0	9		
		Clay, rather hard	3	6		
		Fish-bed and paper shales not distinctly separable from each other	2	0	261	0
Middle Lias.	Spinatus Zone.	Marlstone rock-bed—mostly a hard, compact, crystalline limestone, upper surface green and pebbly	2	9	263	9
	Margaritatus Zone.	Clay, hard, blue, micaceous	9	3	273	0
		Hard grey rock, with much comminuted shell	1	0		
		Clay and rock mixed—very irregular	2	0		
		Clay ; grey, and highly micaceous	5	0		
		Hard mottled rock, green oolitic matrix, red and brown inclusions, also small pebbles	3	0	284	0
	Nitescens Zone.	Clay ; grey, and very micaceous	2	0	286	0

Water first broke through the Fish-bed, but as the well was deepened it apparently came successively from the three upper beds of the Middle Lias, but the real source was the rock-bed, as was proved by a heading. The quantity at first was small, only some 500 or 600 gallons per day, but the pressure great. A heading 50 feet long between the two upper hard beds of the Middle Lias increased the yield permanently to 42,000 gallons per day, and the water rises to within 165 feet of the top of the well. B.T.

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[2] For full particulars *see* "A Record of Two Wells" by Beeby Thompson, *Journ. Northampton. Nat. Hist. Soc.*, Vol. xi., p. 93, 1901.

Walton.

Near Peterborough.

One-inch map N.S 158 ; Geol. map 64. Six-inch map 8 N.E.

1. Boring made and communicated by Mr. J. E. Noble, Thurlby.

Water-level 2 feet 6 inches from surface.

Yield 18,000 gallons per hour.

		Thickness. Ft.	Thickness. in.	Depth Ft.	Depth in.
	Soil	1	0		
Cornbrash	Stone	3	0	4	0
Great Oolite Clay.	Clay	13	0	17	0
Great Oolite Limestone	Rock	9	8	26	8
Upper Estuarine Series	Clay	29	6	56	2
Northampton Beds.	Hard sand	10	6	66	8
	Rock	10	7	77	3
	Black sand (Water bearing)	5	6	82	9
Upper Lias	Clay	18	3	101	0

2. Boring two miles N.W. of Peterborough, close by side of main line.

Made by Mr. J. E. Noble. 1898.

Communicated by Mr. Henry Preston F.G.S.

Water-level, ground level.

		Thickness. Ft.	Thickness. in.	Depth. Ft.	Depth. in.
Cornbrash	Soil	0	4	0	4
	Stone	1	0	1	4
Great Oolite Clay.	Clay	13	8	15	0
Great Oolite Limestone	Rock	6	2½	21	2½
	Blue stone	0	5	21	7½
	Rock	4	4½	26	0
	Clay	2	0	28	0
	Rock	1	2	29	2
Upper Estuarine.	Clay	24	0	53	2
Northampton Beds.	Grey sand	6	0	59	2
	Rock	16	0	75	2
	Black sand	5	10	81	0
Liassic Beds	Clay	79	9	160	9
	Rock	1	3	162	0
	Clay	40	2	202	2
	Clay and stone	12	11	215	1
	Clay	22	0	237	1
	Rock	2	0	239	1
	Clay	3	0	242	1
	Rock	0	9	242	10
	Clay	6	10	249	8
	Rock	0	10	250	6
	Clay	9	2	259	8
	Rock	0	6	260	2
	Clay	19	11	280	1
	Rock	0	6	280	7
	Clay	4	3	284	10
	Rock	0	3	285	1
	Clay	3	0	288	1
	Rock	1	0	289	1
	Clay	12	3	301	4

Warkton.

Cinquefoil Lodge, near Kettering.
One-inch map N.S. 171 ; Geol. map 52 N.W. Six-inch map 25 S.E.
Communicated by Mr. T. Hennell per Mr. Whitaker. 1886.
Yield, no water. Well abandoned.

		Thickness. Ft.
Great and Inferior Oolite Series	Limestone rock [etc.]	77
Upper Lias.	Brown clay	19
		96

Wappenham.

One-inch map N.S. 202. ; Geol. map 53 S.E. ; Six-inch map 55 S.E.
Communicated to Mr. Beeby Thompson by Mr. W. Smart, of Denton. 1907.
Well on high ground S.E. of village.

		Ft.	in.	Ft.	in.
	Soil	2	0		
Glacial	Gravel	22	0	24	0
	Chalky clay	5	6	29	6
Upper Estuarine 15 ft.	Dark tough clay	8	6		
	Yellow clay	1	0	39	0
	Limestone rock	5	6	44	6
Northampton Sand 7 ft. 6 in.	White sand	4	0		
	Sandstone	2	6		
	Black sand	1	0	52	0
Upper Lias.	Blue clay	139	0	191	0
	Rock				

The blue Lias clay increased in hardness to a depth of 191 feet. One stone of bottom rock was removed but not got out of well, the water rising rapidly to a height of 60 feet.

Weedon.

One-inch map N.S. 185 ; Geol. map 53 S.E. ; Six-inch map 43 S.E.

Communicated by Mr. Beeby Thompson.

Weedon is mostly supplied with water from comparatively shallow wells in the Middle Lias, but there are numerous springs about on the hill sides which are also used.

On Weedon Hill to the south of Upper Weedon are numerous Northampton Sand springs, and at Weedon Hill Farm, on the top of the hill, at 500 feet above Ordnance Datum is a well in which the water, from the Northampton Sand, stands about 16 feet from the surface.

Weekley.

One-inch map N.S. 171 ; Geol. map 52 ; Six-inch map 25 S.W.

Communicated by Mr. T. Hennell to Mr. Whitaker.

1. Trial Well nearly half-a-mile S.S.W. of Church. Date 1872.

See also De Rance, *Rep. Brit. Assoc.* for 1878, p. 36.

Yields a small supply of water.

		Thickness. Ft.
Northampton Beds.	Sand	15
	Kale	4
	Rock	10
Upper Lias.	Clay at 29 feet.	29

2. BURTON LATIMER WATERWORKS. Well S.W. OF WEEKLEY. 1886.

Top about 249 feet above Ordnance Datum.

Yields a large supply of water, about 100,000 gallons per day.

		Thickness. Ft.
Drift ?	Stiff clay Clay with shells	44
Northampton Sand.	Hard rock	18
	Clay at 62 feet.	62

Formerly belonging to the Kettering Urban District Council, recently made over to the Kettering Rural District Council for the water-supply of Burton Latimer.

3. Trial boring WEEKLEY HALL WOOD. 1884.

		Thickness. Ft.
Northampton Beds.	Sand	18
	Hard Rock	22
Upper Lias.	Clay at 40 feet.	40

Wellingborough.

One-inch map N.S. 186 ; Geol. map 52 N.W. ; Six-inch map 39 N.E.

Supplied from two wells, and reservoir with storage capacity of 650,000 gallons.

1. EAST END IRON WORKS.

Well sunk 380 feet. No rock (except clay stones) were met with, but blue clay was present all the way.

2. MIDLAND RAILWAY STATION.

At 150 feet the Middle Lias rock-bed was struck, plenty of water.

3. Trial holes in BUSH CLOSE, for the Wellingborough Board of Health, October, 1870.

Communicated by Mr. Edward Sharman, Surveyor.

		Thickness. Ft.	in.	Depth. Ft.	in.
	No. 1.				
Superficial Deposits, Upper Estuarine and Northampton Beds.	Soil	1	3	1	3
	Loam	2	3	3	6
	Clay and stone	3	9	7	3
	Loam	1	9	9	0
	Quicksand	5	6	14	6
	Clay (in part black, the lower part sandy)	6	6	21	0
	Dead sand	1	0	22	0
	Brown clay	8	0	30	0
	Sand and loam	4	0	34	0
	Ironstone	1	0	35	0
	Quicksand	3	0	38	0
	Soft stone	3	0	41	0
	Hard stone	2	0	43	0
Upper Lias.	Blue clay	2	0	45	0
	No. 2. 50 yards from above, 10½ feet lower in elevation.				
Superficial Deposits, Upper Estuarine and Northampton Beds.	Soil	1	0	1	0
	Sand and loam	2	0	3	0
	Light clay over black clay	4	3	7	3
	White sand and loam	3	3	10	6
	Quicksand	3	0	13	6
	Red sand with sandstone	7	0	20	6
	White sandstone	1	6	22	0
	Quicksand	2	0	24	0
Upper Lias.	Blue clay	9	0	33	0

No. 3. 50 yards from No. 2, and 22½ feet lower than No. 1.

		Thickness. Ft.	Thickness. ins.	Depth. Ft.	Depth. ins.
Superficial Deposits.	Soil	1	3	1	3
	Peaty soil, &c.	8	9	10	0
Upper Lias.	Blue clay	13	0	23	0

4. BUSHFIELDS WATERWORKS WELL. No. 1.

Communicated by Mr. Beeby Thompson, incorporating recent information by Mr. E. Y. Harrison, Engineer and Surveyor to the Wellingborough Urban District Council.

Following the borings (in Bush Close) a well was made in 1870, but was never very satisfactory owing to the great quantity of sand constantly entering to block it; consequently a second well was made in 1876, about 60 feet from the first one.

5. BUSHFIELDS WELL No. 2.

Section by Mr. Harrison.

Top 268·7 feet above Ordnance Datum.

		Ft.
	Brash	4½
Upper Estuarine.	Blue clay	10½
Northampton Beds.	Rock	15
Upper Lias.	Blue clay	5
		35

The "rock" included a little white sand.

Yield of water 16,000 to 21,000 gallons per hour, depending upon previous character of the weather. Pumping from 10 to 14 hours will lower the water about 6 feet, and this is less variable than the yield of water.

These waterworks are on a slope like those at Hardwick, and the wells and some 8 or 9 borings show that the upper beds are exceedingly variable in character, being quite different within a few yards, owing to slipping.

The water from Hardwick is pumped to Bushfields, where both waters are softened, a hardness of 38° being reduced to 13° by lime. The softened water is then pumped into a service reservoir to the N.W. of Wellingborough.

6. RED WELL.

About 1 mile N.W. of the centre of Wellingborough.

Source approximately 237 feet above Ordnance Datum.

This one-time noted well, which Charles I. and his Queen came on purpose to drink of in 1628 and 1637, is actually a spring running from the Northampton Sand, which used to deposit a red sediment on the vegetation in the course it took after emergence from the ground. There is little doubt that the water was essentially a swamp water, as any such water will, as a rule, dissolve iron out of the Northampton Sand.

The main portion of the spring used to supply the mill-head of the Corn Mill near Vicarage Farm, and the remainder flowed over a weir into the adjacent brook.

There are two tanks at the spring head, and a line of pipes conveys water from them to a pumping station situated close to the old, disused Corn Mill, whence it is delivered to Messrs. Dulley's Brewery in Wellingborough. It is not strictly correct to say that Messrs. Dulley use the Red Well water, for as Mr. Dulley recently explained to the writer, there are two tanks at the spring head because there are two springs—one coming from the north called the White Well water, and this they use, whereas the one flowing from the south is the real Red Well water, and this they don't use. Of course both can and did flow to the Mill head.

Werrington.

One-inch map N.S. 158 ; Geol. map 64 ; Six-inch map 3 S.W.

1. Boring for GREAT NORTHERN RAILWAY.

Water rose 20 feet above surface.

Top 31 feet above Ordnance Datum.

Made and communicated by Messrs. Le Grand and Sutcliff. Oct., 1898.

Yield 300,000 gallons per diem.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Top soil	6	0		
Oxford Clay	Black clay and few stones	9	0	15	0
	Clay and shale	24	0	39	0
Cornbrash.	Rock	7	0	46	0
Great Oolite Clay.	Clay and stones (septaria)	14	0	60	0
Great Oolite Limestone.	Rock	2	6	62	6
	Hard clay	0	6	63	0
	Rock	7	0	70	0
Upper Estuarine Series.	Clay	3	0	73	0
	Rock	1	0	74	0
	Clay and stones (septaria)	20	0	94	0
	Rock	1	0	95	0
	Clay and stones (septaria)	9	6	104	6
Lincolnshire Limestone.	Rock	27	6	132	0

2. Boring by the side of Railway (G.N.R. Pumping Station).

Made by Mr. J. E. Noble, Thurlby, near Bourne.

Communicated by Mr. Henry Preston, F.G.S.

Water level overflows.

Yield 18,000 gallons per hour.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Clay and gravel	4	0	4	0
Oxford Clay and Kellaways Rock.	Clay	17	5	21	5
	Rock	2	0	23	5
	Hard sand	0	6	23	11
	Rock	1	9	25	8
	Grey sand	5	11	31	7
	Clay	7	11	39	6
Cornbrash.	Rock	7	7	47	1
Great Oolite Clay.	Clay	13	1	60	2
Great Oolite Limestone.	Rock	10	9	70	11
	Clay	2	10	73	9
	Rock	2	0	75	9
Upper Estuarine.	Clay	20	4	96	1
Lincolnshire Limestone.	Rock	36	10	132	11

3. By side of Railway (G.N.R.) Pumping Station.

Made by Mr. J. E. Noble, Thurlby, near Bourne.

Communicated by Mr. Henry Preston, F.G.S.

Surface 31 feet above Ordnance Datum. Water overflows.

The borings Nos. 2 and 3 are 12 feet apart and together do not increase the yield above that from one boring.

		Ft.	in.	Ft.	in.
	Soil	4	0	4	0
Oxford and Kellaways Series.	Brownish and bluish clay	35	0	39	0
Cornbrash	Sandy stone	5	0	44	0
Great Oolite Clay, Great Oolite Limestone and Upper Estuarine Clay.	Soft clay with cherty (?) nodules	8	0	52	0
	Hard clay rock	17	0	69	0
	Clay	4	0	73	0
	Stone	1	0	74	0
	Clay and stone	31	0	105	0
Lincolnshire Limestone.	Brashy rock (water at 112 feet)	7	0	112	0
	Limestone	20	0	132	0

4. Boring made and communicated by Mr. J. E. Noble, of Thurlby, Bourne, to Mr. A. J. Jukes-Browne. Six-inch map 3 N.W.

A fine flow of water was obtained from the lower part of the limestone, the water rising 20 feet above the surface of the ground and the overflow yielding 2,500 gallons per hour,

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Oxford Clay	Clay	77	0	77	0
Cornbrash	Rock	7	10	84	10
Great Oolite Clay	Clay	15	0	99	10
Great Oolite Limestone	Rock	10	3	110	1
Upper Estuarine Series.	Clay	3	6	113	7
	Rock	1	0	114	7
	Clay	20	0	134	7
Lincolnshire limestone	Rock	54	11	189	6

West Haddon.

One-inch map N.S. 185 ; Geol. map 53 N.E. ; Six-inch map 29 S.E.

Communicated by Mr. Beeby Thompson.

1. WEST HADDON LODGE. (On a slope.)

According to Mr. Gilbert, well-sinker (1895), the well was 18 feet deep, with 2 or 3 feet of water [from Northampton Sand.]

2. TORKINGTON FARM.

Well 81 feet deep (another report 92 feet), 58 feet to the water.

Found no bottom to the clay 200 feet down.

3. DARKER'S HOME FIELD.

Top of the hill near to the village, in a field 100 yards to the E. of road, an old well 60 feet deep.

West Haddon stands on the Northampton sand, and like the above wells, derives water from that source. Well-sinkers say they never get to the clay. They stop as soon as they reach the "running sand," a soft loose sand which runs with the water, and breaks in for 6 feet around if any attempt is made to dig.

Wells in village near to church about 15 feet deep. In other parts they range up to 30 feet.

4. MR. INCBEY'S FIELD, ¼ mile towards Winwick. Well 55 feet deep.

5. GUILSBOROUGH ROAD, ¼ mile from West Haddon. Well at cottage 54 feet deep including 5 feet of water.

Weston Favell.

One-inch map N.S. 185 ; Geol. map 52 N.W. ; Six-inch map 45 N.W.

WESTON FAVELL HOUSE, just beyond the second milestone from Northampton along the Kettering Road.

Communicated by Mr. Beeby Thompson.

Several openings were made around the site of the house in 1901, some yielding Great Oolite limestone, others not, although at approximately the same level. Two will illustrate the conditions sufficiently.

1. CONTRACTOR'S WELL, STABLE YARD.

Particulars in part by Mr. Green, Contractor.

			Ft.	in.
Drift ?		Yellowish clay	7	0
		Limestone gravel	0	9
Upper Estuarine.		Variegated clay	6	0
	Estuarine Limestone	Hard blue-hearted rock, somewhat softer and more shaly top and bottom. *Water*	4	0
		Greenish clay, with wood	10	0
			27	9

2. DEEP WELL.

Made by Mr. Green, Contractor.

			Thickness. Ft.	in.	Depth. Ft.	in.
Mostly Upper Estuarine.	1.	Soil and variegated clays and marls, yellow, green and blue, much mixed up with limestone gravel pockets	9	6	9	6
Upper Estuarine. Estuarine Limestone.	2.	Fossiliferous limestone (*a*) Moderately hard, flaky, grey, somewhat argillaceous—yields a little *water*. 3 feet 6 inches (*b*) Very hard limestone rock, required blasting. 1 foot 4 inches	4	10	14	4
	3.	Shale and clay (*a*) Highly fossiliferous grey shale. 2 feet (*b*) Greenish clay with plant markings. 6 feet 6 inches (*c*) Dark purple clay with plants. 3 feet	11	6	25	10
	4.	Variegated clay, red and green, mostly red. Full of little tubes (previously occupied by plant stems ?) This encloses a distinct hard ironstone band, a ferruginous sandstone, about 2 inches thick more or less according to place. Plants in this also	0	6	26	4
	5.	Soft, fine-grained, somewhat argillaceous sandstone, light grey and red, with vertical plant markings	3	2	29	6
		Clear sharp junction.				
Lower Estuarine Beds—Northampton Beds. 26 feet 2 inches.	6.	Dark purple sandstone, soft, fine-grained, somewhat argillaceous, about 1 foot 3 inches, passing irregularly into a yellowish and ruddy sand or soft sandstone with vertical plants. 5 feet 6 inches	6	9	36	3
	7.	Yellow and purple shale—looks slaty in character, but actually breaks as easily in a vertical as in a horizontal direction	0	6	36	9
	8.	Soft purplish-white sandstone with plants. (*a*) Upper part—carbonaceous matter horizontally bedded in thin layers, mostly horizontal ramifying carbonaceous threads (*b*) Lower part—abundant plant marks, vertical and horizontal, but mostly vertical	1	8	38	5
	9.	Sandstone. (*a*) A coarser, purer and whiter sandstone than 8. Fewer plant remains. 1 foot 6 inches (*b*) Light grey sandstone very full of interbedded carbonaceous matter. 3 feet 6 inches (*c*) Highly carbonaceous sandstone, almost black. 1 foot 6 inches	6	6	44	11
	10.	Black carbonaceous clay—yielded a little water	1	6	46	5
	11.	Sandstone, mixed white and red, with some actual ironstone and a little argillaceous matter, passing into more homogeneous red sandstone below	7	0	53	5
	12.	Variegated ironstone—very peculiar. The ironstone yellow, deep red, or black. Radiating crystals of white carbonate of lime common. Other portions looking like pure Hematite. About one foot thick in places, but only occurring in patches, not continuous	0	7	54	0
	13.	Red, somewhat shaly sandstone. A few fossils in layers, but none to be identified. Lower part a softer red and yellow sandstone with vertical plants	1	8	55	8

2. DEEP WELL—*continued.*

			Thickness Ft.	Thickness in.	Depth Ft.	Depth in.
Ironstone Series of the Northampton Sand, 22 ft. 4 in.	14.	Limestone, subcrystalline (some oolitic) excessively hard, bluish grey and brown, with masses of Aragonite; also Corals and other marine fossils	7	0	62	8
	15.	Oolitic rock about as hard as No. 14. (*a*) Hard white oolitic rock 2 ft. 0 in. ? (*b*) Good red oolitic rock with numerous casts of shells in iron-ore. Ironstone of the district 7 ft. 8 in. (*c*) Greenish grey oolitic rock, 3 ft. 0 in.	12	8	75	4
	16.	Limestone, a hard, grey crystalline or subcrystalline rock, slightly oolitic, passing down into red or green oolitic rock with much coral and a few other fossils The base is a greenish coarse-grained (fragmentary) and subcrystalline fossiliferous bed, which represents the usual junction bed between the Upper Lias and the Inferior Oolite	12	8	78	
Upper Lias	17.	Blue clay, micaceous and fossiliferous	8	0	86	0

Water from the basement beds of the Northampton Sand stands some 6 feet above the Clay.

Whiston.

One-inch map N.S. 186; Geol. map 52; Six-inch map 46 S.W.

WELL near to the RECTORY, WHISTON.

B. Thompson, *Journ. Northants. Nat. Hist. Soc.*, Vol. xii., p. 60.

Made in 1896 on the advice of a Diviner. About 18 feet deep in the Northampton Sand and a few feet into the Lias Clay.
No Water.

Whittlebury.

Geol. map 45 N.E.; One-inch map New Series 202; Six-inch map 60 N.W.

Made by Messrs Isler & Co., for W. Cooper, Esq. Date 1903.

Sunk 6 feet, the rest bored.

Rest level of water 66 feet below surface.

Yield about 3,000 gallons in ten hours, when at depth of 150 feet—water from Great Oolite Limestone.

		Thickness. Ft.	Depth. Ft.
Boulder Clay and ? Great Oolite Clay	Clay	2	2
	Clay and flints	3	5
	Mottled clay, stones and flints	12	17
	Clay	16	33
	Loam	14	47
	Clay	20	67
Great Oolite Limestone.	Layer of rock and clay	6	73
	Rock	9	82
	Rock with layer of clay	6	88
	Clay	7	95
	Rock	11	106
Upper Estuarine Series and Northampton Beds	Rock and clay	3	109
	Rock	3	112
	Rock and clay	3	115
	Clay	18	133
	Clay and rock	4	137

		Thickness. Ft.	Depth. Ft.
Upper Lias and probably Middle Lias	Clay	35	172
	Clay and rock	4	176
	Clay	36	212
	Clay and rock	2	214
	Rock	1	215
	Rock and clay	4	219
	Rock	4	223
	Rock and clay	5	228
	Clay	6	234
	Rock and clay	8	242
	Clay	5	247
	Clay and rock	27	274
	Clay	29	303
	Clay and rock	5	308
	Clay	1	309
	Clay and rock	7	316
	Blue clay	40	356
	Rock	4	360
	Clay	11	371

The above grouping is given approximately. The samples seen were pounded and afforded no definite evidence from rocks or fossils; below the depth of 137 feet the specimens were all of blue clays and limestone.—H. B. W.

Wilby.

One-inch map N.S. 186; Geol. map 52 N.W.; Six-inch map 39 S.W.

Communicated by Mr. Beeby Thompson.

At the village of Wilby three possible sources of water exist in the Great Oolite limestone, the Upper Estuarine limestone, and the Northampton Sand. Until recently water was obtained from all three sources by means of wells and superficial freely-running springs: from the Great Oolite limestone very little, from the Estuarine limestone mostly, and the Northampton Sand a little, but there is now a public water-supply, the water being derived from the Northampton Sand by means of a well tapping a permanent spring which runs into the old brickyard on the Northampton road.

On descending the road from Mears Ashby into Wilby one may observe the limestone quarries on the top, below which the wells diminish in depth although reaching to just about the same Ordnance Datum level, and towards the bottom of the hill occurs a roadside spring, also at about the same Ordnance Datum level, which has been very largely used. Thus:—

1. Rectory well, reported to be 50 feet deep.
2. Mr. Johnson's well, 30 feet deep.
3. Well in orchard near Mr. Johnson's well, 30 feet deep.
4. Mr. Corrie's spring by roadside.

The bottom levels of all the above indicate an Upper Estuarine limestone source of water.

5. A well made near to Mr. Corrie's spring is reported to be 28 feet deep and to have yielded water at that depth.

This is probably correct, as 28 feet would be about the proper depth to reach the base of the Northampton Sand at that place (*see* section of Wilby Waterworks well to follow).

WATERWORKS WELL (NO. 1). 1901.

Situation N. of the village of Wilby, second field from Wellingborough and Northampton road, near old brickworks.

Communicated by Mr. Beeby Thompson from information partly supplied by the workmen and partly by Mr. G. F. Bearn, of Wellingborough, and partly from personal observation.

		Thickness. Ft. in.	Depth. Ft. in.
Great Oolite Limestone.	Soil and "rammely" rock	4 0	4 0

Waterworks Well (No. 1). 1901—*continued.*

		Thickness. Ft.	in.	Depth. Ft.	in.
Upper Estuarine.	Yellowish clay	3	0		
	Blue clay, light and dark	2	0		
	White marl	2	0		
	Variegated clay, blue and green	2	0		
	Dark carbonaceous clay, soft	2	0		
	Yellowish clay	2	0		
	Dirt-bed, yellowish and ruddy stuff	3	0	20	0
	Ruddy fossiliferous limestone (Estuarine limestone) in large blocks, yielding water	2	0	22	0
	Light-coloured clay, full of oysters. Pen-earth.	2	0		
	Dark blue clay	3	0	27	0
Lower Estuarine.	White sands, etc.	6	9	33	9
Northampton Sand.	Ironstone beds	11	0	44	9
Upper Lias.	Blue clay	7	10	52	7

The thickness and character of the last three beds has been estimated from sections near. Total depth measured.

Source of water the Upper Estuarine limestone. None whatever from the Northampton Sand, in fact the depth of water is only that of the clay sump, all water in excess runs away. This well was ultimately abandoned.

7. Waterworks Well (No. 2). 1903.

Adjacent to the brickyard, north-east of Wilby village.

Communicated by Mr. Beeby Thompson.

This well picks up a spring that used to run largely to waste through the brickyard.

		Ft.	in.
Northampton Sand.	White sands, Lower Estuarine Beds Ironstone beds.	13	7
Upper Lias.	Blue clay	16	5
		30	0

Wollaston.

One-inch map N.S. 186; Geol. map 52 S.W.; Six-inch map 46 N.E.

Communicated by Mr. Beeby Thompson.

At the present time Wollaston is supplied with water by means of wells almost entirely, though some springs are used to a small extent. The ground level within the village varies by just about 100 feet, and since three or even four sources of water have been tapped, it follows that the depths of the wells are very variable, 6 feet to 58 feet are the limits that have been observed in depths of wells. The three main sources of water are:—The Great Oolite limestone, the Upper Estuarine limestone or its stratigraphical equivalent, and the Northampton Sand. In addition it appears that a marl bed in the midst of the Great Oolite limestone holds up water sufficiently to furnish a supply to some wells. The average distance of level between the Great Oolite limestone (base) source of water and the Upper Estuarine source is 12 feet and between the latter and the Northampton Sand source 24 feet, but whilst the highest and lowest of these three remain pretty constantly 36 feet, the intermediate one seems to vary irregularly.

A selection of the wells is given below with such information about them as was procurable.

1. South End of Village.

To the Upper Estuarine limestone	6 feet.
Water	3 ,,

2. Western Road, South End of Village.

Mr. Lucy's Well. 35 feet deep, about 5 feet of water, from Northampton Sand.

"Marquis of Granby" public-house well. 6 feet deep, about 2 feet of water, from Northampton Sand.

At a little lower level than the last, a spring discharges on the slope from the Northampton Sand.

3. EASTERN ROAD, NORTHERN SIDE, SOUTH END OF VILLAGE.

Mr. Brown's Well, and another near to.

	Ft.
Great Oolite limestone	18
Clay	3
	21

Another well near the above—(probable section).

		Ft.
Great Oolite	Limestone	26 ?
Upper Estuarine.	Clay	9 ?
	Oyster bed	3 ?
	Clay	4 ?
		42

South side of road.

Great Oolite	Limestone	20
Upper Estuarine	Clay	7
		27

4. EAST OF THE MAIN STREET, SOUTHERN END.

Well.		Ft.
Great Oolite	Limestone	19 ?
Upper Estuarine	Blue clay with oysters	6 ?
		25

Well in coal-yard.		Ft.
Great Oolite	Limestone	14
Upper Estuarine	Blue clay with oysters	7½
		21½

Another well near to above.

Depth between 50 feet and 60 feet.

Coal sand said to have been found at about 45 feet down (a carbonaceous Lower Estuarine bed, no doubt).

Water evidently derived from Northampton Sand.

5. FURTHER EASTWARD OF THE MAIN STREET.

Well to new houses. 1899.

		Ft.
Great Oolite	Limestone	19
Upper Estuarine	Dark coloured carbonaceous clay	6
		25

Other wells near, but a little further eastward, 60 feet deep—much water, obviously Northampton Sand source.

A little further north and east of the last described.

Well.		About Ft.
Great Oolite	Marl and limestone	7
	Solid limestone	5
	Marl	6
	Limestone	5
	Marl	4
Upper Estuarine	Clay	6
		33

Water stood 7 feet 6 inches in the well.

This section is particularly interesting as giving probably a complete section of the Great Oolite limestone group, in which the position of the somewhat impervious intermediate marl is shown.

Well quite near to the last described.

		Ft.
Great Oolite	Marl and limestone as above	27
Upper Estuarine	Clay	10
Lower Estuarine and Ironstone Beds?	——— ? Shale near bottom	21
		58

No doubt a Northampton Sand water-supply, but singularly less water than in the last described well.

It seemed more difficult to obtain reasonably reliable particulars of old wells in the northern part of Wollaston, but they are doubtless of a similar nature to those described.

Woodford.

(Near Thrapston.)

One-inch map N.S. 186 ; Geol. map 52 N.W. ; Six-inch map 33 N.W.

WOODFORD HOUSE.

Communicated by Mr. Beeby Thompson.

From information given by Mr. J. T. Blackwell, of Kettering, and Mr. Sharp.

Top of Boring 275 feet above Ordnance Datum.

			Approximate.	
			Ft.	Ft.
Upper Boulder Clay.		Brown clay with chalk	10	10
		Darker blue clay with chalk	25	35
Mid-Glacial Sands.		Sand and gravel yielding *water* at 40 feet	5	40
Great Oolite Limestone.		Hard brown stone	10	
		White stone	7	57
Upper Estuarine.		Variable clays	33	90
Northampton Beds.	Lower Estuarine.	Sands	9	
	Ironstone Series.	Red Ironstone	11	
		Blue ironstone, with water at 104 feet	2	112
Upper Lias.		Blue clay	30	142

Yield of water about 17,000 gallons per day.

Woodford Halse.

One-inch map N.S. 202 ; Geol. map. 53 S.E. ; Six-inch map 50 S.W.

Some trial borings made on WOODFORD HILL, E. of Woodford Halse, for the Woodford Halse Water Company.

Communicated by Mr. Beeby Thompson from information supplied by Mr. J. B. Williams, of Daventry, 1903.

The seven borings are given below in the order of their relative heights above Ordnance Datum.

Borings Nos. 4 and 7. Height 583·57 above Ordnance Datum.

		Ft.	in.
	Soil	1	0
	Yellow clay	3	0
	Yellow clay and limestone	9	0
	(*water stands about midway.*)		
	White limestone	4	0
	(*water at base.*)		
	Yellow clay or Marl	3	0
	Blue clay	10	0
	Blue clay and limestone bits	1	0
	Limestone	7	0
	Rock	1	6
	Rock	1	3
	Yellow limestone	1	3
Upper Estuarine.	Blue clay with black markings	9	0
		51	0

No satisfactory interpretation of this section can be given ; it may be on or close to one of the Faults, as there seems to be a repetition of beds (Great Oolite limestone, etc.)

In the same field as this boring water is said to "boil up" along a particular line after heavy rain which may be the line of the "fault"

Boring No. 1. Height 564·88 above Ordnance Datum.

		Ft.
	Soil	2
Northampton Sand.	Ironstone and sand	32½
	Ironstone pieces	½
	Ironstone and sand	5
	Dirty sand	10
Upper Lias.	Blue clay	4
		54

Water found 24 feet down, and rose a little over 6 feet when tapped.

The Northampton Sand here no doubt includes the Lower Estuarine beds usually white sand.

Boring No. 3. Height 548·18 above Ordnance Datum.

		Ft.
	Soil	2
Northampton Sand.	Sandstone	5
Upper Lias ?	Yellow clay	3
	Blue clay	16
		26

Boring No. 6. Height 546·70 above Ordnance Datum.

			Ft.
		Soil	2
Northampton Beds.	Lower Estuarine	Black bog	7
	Ironstone beds.	Sand and Ironstone	28
		(Uncertain)	1
	Upper Lias.	Blue clay	10½
			48½

Water found at 9 feet, rose 5½ feet.

Boring No. 2. Height 540·98 above Ordnance Datum.

		Ft.
	Soil	2
Northampton Sand	Sandstone	5
Upper Lias.	Blue clay	17
		24

Boring No. 5. Height 534·6 above Ordnance Datum.

		Ft.
	Soil	2
Northampton Beds.	Black bog	6
Upper Lias.	Boggy clay	7
	Clay	1
	Blue clay	24
		40

The Black bog referred to in two of the borings consisted of fine ferruginous sand mixed with much vegetable matter. The organic acids produced by the decomposition of this vegetable matter dissolved the iron, and after a heavy fall of rain this solution of iron percolated into the wells supplying Woodford with water, causing an inky taste, very considerable deposit of the hydrated peroxide in the reservoir and service pipes, and in the water drawn from the latter. On the advice of Mr. Beeby Thompson the water running into the particular bog which gave trouble was diverted, the bog was largely dug out and the material calcined, and numerous deep drains were put in, and apparently the defect is completely remedied.

Wothorpe.

One-inch map N.S. 157 ; Geol. map 64 ; Six-inch map 12 S.W.

Marquis of Exeter's Estate.

Section of bore-hole at Wothorpe, for supply of Stamford, Wothorpe, and Wittering.

About 150 feet above Ordnance Datum.

Communicated by Mr. H. Sykes, 66, Bankside, London. 30th September, 1896.

		Thickness.	Depth.
		Ft.	Ft.
	Made ground	8	81
Upper Lias.	Clay	109	117
	Rock	3	120
	Blue clay	4	124
Middle and Lower Lias.	Ironstone rock	8	132
	Clay and stones	104	236
	Ironstone rock	2	238
	Clay and stones	5	243
	Limestone rock	1	244
	Hard dry clay and stones	7	251
	Limestone rock	1	252
	Clay and shells	1	253
	Limestone rock	2	255
	Clay and stones	6	261
	Limestone rock	1	262
	Clay	8	270
	Very hard rock	5	275
	Clay and stones	5	280
	Grey marble rock	11	291
	Clay and shells	11	302
	Rock	2	304
	Clay	6	310

H.B.W.

Yardley Hastings.

One-inch map N.S. 203 ; Geol. map 52 S.W. ; Six-inch map 53 N.W.

Communicated by Mr. Beeby Thompson from information supplied by Mr. W. Smart, and personal observation.

1. Park Road Cottages.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	3		
Boulder Clay ?	Clay	12	0	13	3
Great Oolite Limestone.	Rock	6	0		
	Hard marl	10	0	29	3
? Upper Estuarine.	Clay	8	9		
	Strong blue rock	6	0		
	Hard blue marl	4	0	48	0

Water rises 10 feet ; quantity about 350 gallons per hour.

2. Roundhay Farm (about 1 mile E.S.E. of Yardley Hastings).

Well. Top, about 358 feet above Ordnance Datum.

Water at 118 feet.

Since typical Cornbrash, purple clay, and Great Oolite limestone were found ; obviously the water came from the latter.

3. New House, nearly opposite the Lodges to Castle Ashby. W. of Yardley Hastings.

Well. Top, about 290 feet above Ordnance Datum.

		Ft.
Boulder Clay.	Soil	1
	Chalky clay	12
	Yellow shelly rock in thin slabs (Pendle)	4
Great Oolite Limestone.	Yellowish marl or soft limestone	4
	Blue limestone, with numerous Trigonias, not pierced, water.	12
		33

ANALYSES OF WATERS.

BEDFORDSHIRE.

Mineral springs of a saline chalybeate nature, some of which have in old times, been regarded as Holy Wells and utilized for medicinal purposes, have been noted to occur at the following localities [1] :—

Bromham, near Wells Lane.
Clapham, north of the Bedford Waterworks.
Cranfield, probably at Hartwell Farm.
Flitwick.
Hail Weston.
Holcot (or Holcutt).
Holwell, formerly a Holy Well.
Milton Ernest.
Oakley.
Pertenhall, Chadwell.
Silsoe, Wrest Gardens.
Stevington, Holy Well.
Turvey, St. Mary's Well.

At Turvey (Dove House Close) a spring of a "petrifying" nature occurs.

From information given by Dr. C. E. Prior to Mr. Cameron, analyses of waters from shallow wells in the valley gravel near Bedford show (where uncontaminated) from about 36 to 52 grains of solid matter per gallon.

A considerable amount of chloride of sodium has been met with in well-waters apparently derived from the Kellaways Beds, in wells sunk through Oxford Clay at Kempston, Wootton, Stanton, Lower Shelton, and Marston Moretaine. The solid ingredients in some of these wells as recorded by Dr. C. E. Prior, amount to from 188 to 250 grains per gallon.[2] The water may be in part derived from the Ouse drainage area through the valley gravels.

Ampthill.

1. JOINT ISOLATION HOSPITAL Supply.
From Gipsy Lane Spring in Lower Greensand (*see* p. 30).
Communicated by the Local Government Board.
By Sir Thomas Stevenson, M.D., F.R.C.P., F.I.C. 1904.

Water free from odour, and when viewed in bulk colourless and very slightly turbid.

	Results in grains per gallon.
Total solid matter	15·68
Loss on ignition	2·52
Ammonia	0·0005
Albuminoid or organic ammonia	0·003
Combined chlorine	1·05
Equal to common salt	1·73
Nitrogen as nitrates	0·36
Nitrites	None.
Oxygen required to oxidise the organic matter	0·037

Hardness.	Degrees.
Temporary	3·8
Permanent	5·0
Total	8·8

Chemical analysis shows this to be a good water of very moderate hardness, and of high organic purity.

The turbidity was due to mineral matter.

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[1] See notes by A. C. G. Cameron in R. C. Hope's Holy Wells of England, 1893, pp. 1, 2.

[2] Report on Bedfordshire Well-waters, 1888; *See* also A. J. Jukes-Browne, *Midland Naturalist*, vol. xiv. 1891, p. 205, and *Geol. Mag.* 1889, p. 360.

2. SPRING, just SOUTH OF WORKHOUSE.

By Mr. Alfred Ashby.

	Results in parts per 100,000.
Free ammonia	·0015
Albuminoid ammonia	·0056
Chlorine	3·10
Nitrous acid	0·00
Nitric acid	10·32
Phosphoric acid	trace
Total solids	39·36
Oxygen absorbed from Permanganate at 80° in 15 hours	·0133
Oxygen absorbed from Permanganate at 80° ,, 24 ,,	·0330

Hardness.	Degrees.
Total	15·5
Permanent	15·
Temporary	0·5

3. THE FIRS.

By Dr. B. Dyer.

Communicated by Mr. A. C. G. Cameron.

	Results in grains per gallon.
Total dissolved matter	38·00
Loss on burning residue	5·00
Free ammonia	·006
Organic ammonia	·004
Chlorine in chlorides = chloride sodium 5·93	3·60
Nitrogen as nitrates = nitric acid 8·12	2·11
Oxygen absorbed in 15 minutes	·002

Aspley Guise.

BIRCHMOOR.

Source, Well, 43 feet and boring 200 feet in Lower Greensand.

Yield 10,000 gallons per hour.

By Sir T. Stevenson.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid matter	8·40
Loss on ignition	1·40
Ammonia	0·001
Albuminoid ammonia	0·0035
Combined chlorine	1·14
Equal to common salt	1·88
Iron in solution	almost nil
Nitrogen as nitrates	0·10
Nitrites	none
Oxygen required to oxidise the organic matter	0·027

Hardness.	Degrees.
Temporary	1·8
Permanent	1·0
	2·8

The action of the water on lead was found to be almost nil. There is no doubt this is a water of excellent quality, and in addition has the virtue of being exceedingly soft.

Barton-in-the-Clay.

Leet Wood, $\frac{3}{4}$ mile S.E. of Church.

SPRING from Totternhoe Stone in BARTON HILLS.

By Mr. W. Chattaway, F.I.C 1894.

	Result in Grains per gallon.
Total solid matter	25·0
of which Organic matter (volatile) formed	7·8
Mineral matter	17·2
Chlorine	1·3
	Degrees.
Hardness	14·0

Spring from Totternhoe Stone in BARTON HILLS—*continued.*

	In parts per million.
Nitrogen as ammoniacal salts	0·032
,, Albuminoid ammonia	none
,, Nitrates	8·230

No trace of lead or other injurious metal.

Bedford.

1. From SERVICE RESERVOIR AT WATERWORKS.

Communicated by Mr. A. C. G. Cameron.

Apothecaries' Hall, Blackfriars,
London,
April 1st, 1898.

Report upon a sample of water received from Mr. John Lund on the 22nd March.

The sample was dated 21st March, 1898.

On analysis the sample gave the following results :—

Physical Characters.

Colour (appearance of a column 2 feet in length)	Very Satisfactory.
Taste	Very Satisfactory.
Smell	Very Satisfactory.

Analytical Characters.

	Grains per gallon
Total solids	50·5
Fixed solids	46·1
Volatile solids	4·4
Chlorine	1·8
Equivalent to Sodium Chloride	2·9

	Degrees.
Total hardness	20·5
Temporary hardness	13·8
Permanent hardness	6·7

Each degree of hardness is equivalent to the hardness produced by one grain of chalk per gallon.

Nitrogen (expressed as parts per million).

As free ammonia	Trace only.
As albuminoid ammonia	0·048
As nitrates	Trace only.
As nitrites	Absent.
Oxygen absorbed in 4 hours	0·29
Oxygen absorbed in 15 minutes	0·15
Phosphates	Absent.
Poisonous metals	Absent.

In addition to the foregoing analysis, I have submitted the sample to a very thorough bacteriological examination. The results thus obtained are extremely satisfactory. The entire number of micro-organisms was only 170 per cubic centimetre, but by most approved methods of examination I have been unable to find any organisms of a suspicious character. Particular attention was paid to such organisms as would indicate contamination by ordinary sewage, but none of these could be discovered. Taking into consideration the whole of these figures I am of opinion that this water is extremely satisfactory; indeed the only figure obtained on the sample which would indicate the least suspicion is that of Nitrogen existing as Albuminoid Ammonia, but in my opinion this is fully accounted for by the possible introduction of traces of vegetable matter on its way to the service reservoir, or possibly in the reservoir itself.

WM. CHATTAWAY, F.I.C.,
Chemist to the Society of Apothecaries.

From the *Bedfordshire Standard, April 29th*, 1898.

2. Analysis of water from Heading at Bedford Waterworks, by Mr. J. Kear Colwell, May, 1903. From report by Major Tulloch.

	In parts per 100,000.
Oxygen absorbed in one hour	·328
Albuminoid ammonia	·014
Nitrogen as nitrates	·032
Hardness.	
Temporary	20·9
Permanent	11·6
Total	32·5

3. River Ouse at Bedford Waterworks.

Analysis communicated by Prof. J. Attfield to Mr. Cameron. 1886.

	Grains per gallon.
Total solid matter, dried at 248° F.	29·00
Ammoniacal matter, yielding 10 per cent. of nitrogen (equal to Ammonia per million)	0·04
Albuminoid organic matter, yielding 10 per cent. of nitrogen (equal to ammonia per million 0·12)	0·07
Nitrites	none.
Nitrates containing 17 per cent. of nitrogen (equal to grains of nitrogen per gallon, traces)	traces.
Chlorides, containing 60 per cent. of Chlorine (equal to grains of chlorine per gallon, 1·7)	2·8
Hardness, reckoned as chalk grains or "degrees," removed by ebullition	10·0
Unaffected by ebullition	4·5
Total hardness	14·5
Lead or Copper	none.

"The water from the Ouse at Bedford contains just those calcareous, saline and organic substances which rain would naturally dissolve from the cultivated soil characteristic of the part of the county through which that river flows. The water is somewhat hard, though only about half the hardness of the water pumped from the subjacent Oolitic Limestone. The saline substances are of no moment. The organic matter is not in excessive proportion, especially considering that the sample analysed has not been subjected to any process of filtration. On the whole the water compares favourably with other river-waters which, after due filtration, are used for drinking and other purposes by town populations."

4. Bedford Brewery, Lurke Street.

Communicated by Mr. F. C. Fuller to Mr. Cameron, 1896.

By Mr. John Heron, F.I.C., F.C.S.

Analysis of *new* well water, 1896.

Hardness before boiling	85·0	degrees.
Hardness after boiling	27·6	"

1 degree equals 1 grain of Carbonate of Lime per gallon.

	Grains per gallon.
Free ammonia	0·001
Albuminoid ammonia	0·008
Oxygen absorbed in 1 hour	0·077
do. do. in 3 hours	0·088
Nitrogen as nitrates and nitrites	1·466
equals nitric acid	2·100
Chlorine	7·56
Sulphuric anhydride	31·77
Carbonic anhydride	9·49
Lime	28·84
Magnesia	3·23
Potassium	8·12
Sodium	1·55
Oxides of iron and aluminium	none.
Silica	1·96

4. BEDFORD BREWERY, LURKE STREET.—*continued.*

The mineral constituents are probably combined as follows :—

Sulphate of lime	40·70	Grains per gallon.
Sulphate of magnesia	9·69	,, ,,
Carbonate of lime	21·57	,, ,,
Sulphate of potassium	2·49	,, ,,
Nitrate of potassium	3·37	,, ,,
Chloride of sodium	3·92	,, ,,
Chloride of potassium	10·89	,, ,,
Silica	1·96	,,
Total mineral matters	94·59	

Biggleswade.

Source. Trial borehole, 2 miles S.E. of Biggleswade. 174 feet deep. (*See* p. 39).

By Sir Thomas Stevenson, M.D., F.R.C.P. 1904.

Communicated by the Local Government Board.

Water free from odour, and when viewed in bulk, colourless and slightly turbid: it is quickly clarified by subsidence. The sample was stated by Mr. G. F. Deacon, to have been taken on December 30th, 1903, whilst the well was being pumped at the rate of about 750,000 gallons a day.

	Results in grains per gallon.	Parts per 100,000.
Total solids	26·60	38·00
Loss on ignition	1·68	2·40
Combined Chlorine	1·09	1·56
Equal to common salt	1·80	2·57
Nitrogen as nitrates	traces	traces
Nitrites	none	none
Iron in solution	·014	·02
Iron in suspension	·056	·08
Total iron	·07	·10
Ammonia	·0085	·0121
Albuminoid Ammonia	·0025	·0036
Oxygen absorbed	·024	·034
Hardness—	Degrees.	Degrees.
Temporary	16·4	23·4
Permanent	2·0	2·9
Total	18·4	26·3

These results show that the water is an excellent one, not unduly saline, or hard, and most of the hardness due to calcium carbonate removable by boiling It is of a high degree of purity.

Clophill.

TRIAL BORING FOR AMPTHILL.

Communicated by the Local Government Board.

1. Boring 107 feet through Lower Greensand (under a few feet of surface drift) to Oxford Clay.

A. By Sir Thos. Stevenson, M.D., F.R.C.P., F.I.C., 1901.

	Results in grains per gallon.
Total solid matter	26·60
Loss on ignition	1·12
Ammonia	0·0105
Albuminoid or Organic Ammonia	0·0015
Combined chlorine	1·26
Equal to common salt	2·08
Nitrogen as nitrates	0·02
Nitrites	none
Oxygen required to oxidise organic matter	0·013

1. Boring 107 feet through Lower Greensand (under a few feet of surface drift) to Oxford Clay.—*continued.*

Hardness.	Degrees.
Temporary	15·5
Permanent	3·5
	19·0

The sample was faintly opalescent from the presence in suspension of a trace of earthy matter, due no doubt to recent operations at the well, and of a temporary character. This water is of excellent quality. It is of no excessive hardness, and the greater part of the hardness is removable by boiling. The iron present is quite inconsiderable, and no injurious metallic compounds are present.

The water is of a very high degree of organic purity, and analysis reveals no trace of pollution.

This water will form an excellent pure public supply, well-fitted for drinking and all other domestic purposes.

B. By Dr. P. F. Frankland, 1901.

	Results in parts per 100,000.
Total solid matters	37·56
Organic carbon	·054
Organic nitrogen	·014
Ammonia	·014
Nitrogen as nitrates and nitrites	trace
Total combined nitrogen	·025
Chlorine	2·0
Hardness.	Degrees.
Temporary	21·2
Permanent	10·9
Total	32·1

"The water although opalescent is palatable and of a very high degree of organic purity. Like many Greensand waters, it contains an appreciable proportion of ammonia but is practically free from nitrates. It is a 'hard' water, but the hardness is mostly of the 'temporary' kind and could be reduced to about one-third of its present amount by softening with lime. I have tried the softening on a small scale and find that it also entirely removes the opalescence which does not disappear without treatment. After softening, this water would be of most excellent quality not only for drinking but for all domestic purposes."

2. Source.

Boring 122 feet in Lower Greensand. Water-level 26 feet below surface, fell to 55 feet from surface during test pumping, regaining its original level in 42 hours. Yield 693,384 gallons in 6 days' pumping, or 115,564 gallons per day.

By Sir Thomas Stevenson, M.D., F.R.C.P., F.I.C., 1904.

Communicated by the Local Government Board.

	Results in grains per gallon. 1.	2.
Colour	none	none.
Odour	"	"
In suspension :—		
Total solid matter	47·98	8·40
Oxide of iron	0·39	0·31
In solution :—		
Total solid matter	33·60	36·68
Losing on ignition	2·80	3·36
Combined chlorine	1·81	2·38
Equal to common salt	2·99	3·93
Nitrogen as nitrates	0·005	0·005
Nitrites	none	none
Oxide of iron	minute trace	minute trace
Ammonia	0·004	0·0045
Albuminoid or organic ammonia	0·002	0·002
Oxygen required to oxidise the organic matter	0·019	0·021

2. Source.—*continued.*

Hardness (Clark's scale).	Degrees. 1.	2.
Temporary	19·5	18·0
Permanent	6·0	7·0
Total	25·5	25·0

Both these waters are rather hard Greensand waters ; but about three-fourths of the hardness is removable by boiling. Their organic purity is very high and chemical analysis reveals no trace of pollution. It will be noted that the second water differs from the first in respect of chlorides only. As to iron in the first sample it is impossible to state that the iron present in the sediment had been deposited from solution in the water, seeing that a large quantity of earthy matter was in suspension. The small ferruginous deposit from the second sample had apparently been in part deposited from solution in the water ; but this ferruginous deposit was very small. In both samples practically no iron remained in solution, and the water was, when freed from suspended matter, of good quality—pure and hard.

Eaton Bray.

Public Well in Market Square.
Report and analysis by Dr. J. C. Thresh.
Communicated by the Local Government Board.

	Results in grains per gallon.	Parts per 100,000.
Chlorine	6·1	8·7
Expressed as Chloride of Sodium	10·05	14·3
Nitrogen expressed as Nitric Acid	·46	·66
NHO_3	2·0	2·85
Nitrates	nil.	nil.
Hardness.	Degrees.	Degrees.
Temporary	11·0	15·7
Permanent	17·0	—
Total	28·0	—
Lead, Zinc, Iron	nil.	nil.
Free Ammonia	·000	·000
Organic Ammonia	·0021	·003
Oxygen absorbed at 80° F. in 4 hours	·0168	·024

The chemical examination of this water is quite satisfactory. There are no indications of pollution, and the hardness is not excessive. The bacteriological examination is equally satisfactory.

Eaton Socon.

Analysis communicated by Dr. J. C. Thresh.

1. Well in gravel, 12 feet deep, near River Ouse.

	Results in grains per gallon.
Chlorine in chlorides	3·9
Nitrogen in nitrates	1·5
Permanent hardness	4·3
Temporary hardness	17·5
	Parts per million.
Free ammonia	0·03
Organic ammonia	0·05

2. Well about 12 feet deep in River gravel.
About ½ mile below 1.

	Results in grains per gallon.
Chlorine in chlorides	3·2
Nitrogen in nitrates	1·0
Permanent hardness	6·0
Temporary hardness	11·8
	Parts per million.
Free ammonia	0·10
Organic ammonia	0·07
Oxygen absorbed (4 hours, 80° F.)	2·52

Flitwick.

By Mr. William Johnstone, *The Analyst*, Vol. xii., No. 133, pp. 90-93.

This ferruginous water issues from a peaty deposit on Flitwick Moor, in a valley cut through the Lower Greensand to the Oxford Clay.

	Results in parts per 1,000.	Grains per Imp. gallon.
$(NH_4)_2O$	·1144	8·008
CaO	·0640	4·480
MgO	·0511	3·577
Fe_2O_3	1·2212	85·484
Al_2O_3	·0044	·308
CuO	·0075	·525
MnO	·0014	·098
K_2O	·0024	·168
Na	·0211	1·477
Cl	·0340	2·380
SO_3	1·7328	121·296
SiO_2	·2328	16·296
Organic matter	1·2753	89·271
	4·7624	333·368

Constituents in Combination.

	Parts per 1,000.	Grains per Imp. gallon.
$(NH_4)_2SO_4$	·29040	20·3280
$CaSO_4$	·15525	10·8675
$MgSO_4$	·15340	10·7380
$Fe_2 3SO_4$	1·92138	134·4966
$Al_2 3SO_4$	·01470	1·0290
$CuSO_4$	·01508	1·0556
$MnSO_4$	·00299	·2093
K_2SO_4	·00527	·3890
NaCl	·05520	3·8640
Iron Apocrenic	1·39000	97·3000
Iron Crenic	·26840	18·7880
SiO_2	·23280	16.2960
Organic matter	·25730	18·0110
	4·76217	333·3519
Total by direct estimation at 140°C.	4·8000	336·000
Specific gravity at 15·5°C.	1·0041.	

Note by Mr. Jukes-Browne :—

The valley of the Flit at this locality is cut down through the Lower Greensand to the Oxford Clay, but the valley floor is occupied by a wide spread of gravel covered by a rich alluvial soil which includes a considerable area of crumbly ferruginous peat. It is through this peat that the water wells up and it evidently derives some of its dissolved ingredients from the peat, though the iron may in the first instance have come from the sands of the Lower Greensand. The water is, of course, derived from those sands, and is thrown out by the underlying Oxford [or Ampthill] Clay.

Where the water runs in open channels it deposits a tufaceous looking deposit of bog-iron ore, but where the water runs into covered troughs and is preserved for use, the iron is held in solution. In 1885 much of it was running to waste, but it has since been taken up, bottled, and sold as Flitwick Water.

A.J.J.B.

Kempston.

1. Meadow Farm, 3¼ miles S.W. of Kempston Church.

	Grains per gallon.
Total solid residue	289·52
Oxidisable organic matter	1·18
Nitric acid	None.
Chlorine	94·38=155·52 chloride of sodium
Free ammonia	·075
Albuminoid ammonia	·003

This water is simply an impossible one to contemplate using as a regular supply, either for drinking or general domestic use. The amount of salt is enormous.

Hanover Square, W. J. Aug. Voelcker.
June 7, 1898.

2. KEMPSTON BURY.

For Mr. W. S. H. Harter.

Water from Gravel.

Communicated by Mr. Cameron.

	Grains per gallon.
Total solid residue	82·88
Containing :—	
Oxidisable organic matter	2·02
Chlorine	2·30
Equal to chloride of sodium	3·80
Nitric acid as nitrates	·10
The water also contained :—	
Free ammonia	None.
Albuminoid ammonia	·0075
Hardness according to Clark's scale	62°

The water was turbid, as it would naturally be expected in a newly sunk well. The total solid residue, which consisted very largely of sulphate of lime with magnesia, is so considerable, and renders the water so excessively hard, that it is unfit for domestic uses, such as cooking, etc., and not suitable for dietetic purposes.

Hanover Square, W. J. AUG. VOELCKER.
Jan. 14, 1891.

Leighton Buzzard.

Source. Well in Lower Greensand : Well 40 ft. and borehole 160 ft. =200 ft.

Communicated by the Local Government Board.

(N.B.—The District Council have since undertaken works.)

By Prof. John Attfield, Oct., 1897.

The appended analytical data show that these samples of water are remarkably free from contamination by organic (animal or vegetable) matter and from excessive proportions of inorganic (mineral) substances. They contain a perfectly harmless trace of iron, which soon settles. While settling, the water is unsightly; on the other hand, the iron affords a guarantee against organic impurity. I should prize such water as a town supply, but more especially if the iron could be deposited by exposure in reservoirs or otherwise *before* delivery to consumers.

	Results in grains per gallon.
Total suspended solid matter, dried at 250 F.	Traces.
Total dissolved solid matter, dried at 250 F.	20·5
Ammoniacal matter, yielding 10 per cent. of nitrogen (equal to ammonia per million, ·150)	·09
Albuminoid organic matter, yielding 10 per cent. of nitrogen (equal to ammonia per million, ·070)	·04
Nitrites	None.
Nitrates, containing 17 per cent. of nitrogen (equal to grains of nitrogen per gallon, ·04)	·22
Chlorides, containing 60 per cent. of chlorine (equal to grains of chlorine per gallon, 1·15)	1·9
Hardness, reckoned as chalk-grains or degrees :—	
Removed by ebullition	11·0
Unaffected by ebullition	3·0
Total hardness	14·0
Lead or copper	None.
Physical Examination, a faint brownish tinge	(Iron.)
Oxygen absorbed in 3 hours (by iron)	·16

Water taken at 26, Hockliffe Street. October 5th, 1897.

	Results in grains per gallon.
Total suspended solid matter, dried at 250 F.	traces.
Total dissolved solid matter, dried at 250 F.	19·5
Ammoniacal matter, yielding 10 per cent. of nitrogen (equal to ammonia per million ·016)	·01
Albuminoid organic matter, yielding 10 per cent of nitrogen (equal to ammonia per million ·036)	·02

Water taken at 26, Hockliffe Street, October 5th, 1897.—*continued.*

	Results in grains per gallon.
Nitrates, containing 17 per cent. of nitrogen (equal to grains of nitrogen per gallon ·04)	·22
Nitrites	None.
Chlorides, containing 60 per cent. of chlorine (equal to grains of chlorine per gallon 1·2)	2·0
Hardness, reckoned as chalk grains or degrees, removed by ebullition	9·0
Unaffected by ebullition	4·0
Total hardness	13·0
Lead or copper	none.
Physical examination, a faint brownish tinge	(iron)
Oxygen absorbed in three hours (by iron)	0·09

Other analyses of Well-water from Leighton Buzzard and neighbourhood, were printed in E. W. Lewis' "Lectures on the Geology of Leighton Buzzard," 1879, p. 81.

Luton.

1. Source. Deep wells in chalk for WATER COMPANY.

By Mr. Arthur E. Ekins, F.I.C., February, 1901.

	Results in grains per gallon.
Total solid matters	23·0
Chlorine	1·1
Free ammonia	0·000
Albuminoid ammonia	0·0008
Nitrites	None
Oxygen absorbed in 15 minutes	0·015

This water is clear and bright, and possesses an extremely high degree of organic purity, and is of excellent quality for dietetic purposes.

2. PUBLIC SUPPLY.

Communicated by Dr. J. C. Thresh.

Well near Crescent Road, Luton. Ground level + 372·4 feet above Ordnance Datum.

Water level when at rest 35·7 feet below ground surface.

Well sunk 52 feet, bored to 340 feet, all in chalk.

	Results in parts per 100,000.
Calcium carbonate	20·3
Calcium sulphate	1·85
Calcium nitrate	4·1
Calcium chloride	·95
Magnesium chloride	·6
Sodium chloride	·55
Silica, etc.	1·65
Total solids	30·0

Hardness.	Degrees.
Permanent	6
Temporary	19

	Parts per million.
Free ammonia	·000
Organic ammonia	·001
Oxygen absorbed in 4 hours at 80° F.	·007

3. Private well near CHAPEL STREET.

Communicated by Dr. J. C. Thresh.

Water level 50 feet from surface. Section—chalk capped with sand and gravel.

	Results in parts per 100,000.
Calcium carbonate	23·7
Calcium sulphate	7·1
Calcium nitrate	12·9
Magnesium chloride	1·35
Sodium chloride	4·8
Silica, etc.	2·15
Total solids	52·0

Hardness.	Degrees.
Permanent	12
Temporary	16½

3. Private well near Chapel Street.—*continued.*

	Parts per million.
Free ammonia	·000
Organic ammonia	·000
Oxygen absorbed	·007

Marston Moretaine.

From the well in the yard at Church End Board School.

Analysis by Mr. G. Squire, about 1886, for Messrs. Adams & Co., Sanitary Engineers, Little Queen Street, Westminster.

Total solid matter per gallon, 139 grains—before filtration.

Ammonium Chloride	2·
Calcium Carbonate	34·
Calcium Sulphate	12·
Magnesium Sulphate	3·5
Sodium Chloride	79·
Ferric Oxide	3·5
Silica	2·
Loss	3·
Total	139 grains.

Maulden.

From a spring at Duck End, ¾ miles west of Maulden Church. Issues at the base of the Lower Greensand.

Analysis by Dr. A. Voelcker. Communicated by Mr. A. C. G. Cameron.

	Results in grains per gallon.
Total solids	30·40
Oxidisable organic matter	·29
Oxide of iron and alumina	·42
Lime	9·66
Magnesia	1·31
Sulphuric acid	9·13
Nitric acid	2·58
Chlorine	1·77
Equal to Chloride of sodium	2·92
Also free ammonia	·0168
Albuminoid ammonia	·007

The water was colourless with a small deposit of oxide of iron, and is permanently hard.

Moggerhanger.

Communicated by the Local Government Board.

Source. Spring from gravel bed over clay, in railway cutting near Blunham Station.

Yield about 1,000 gallons a day.

By Mr. John C. Umney. August, 1897.

The water was fairly clear and on standing threw down only a very slight deposit.

Total solids	34 grains per gallon.
Chlorine (as chlorides)	2·1 „ „ „
Free ammonia	·06 parts per million.
Albuminoid ammonia	·09 „ „ „
Nitrogen as nitrites	Nil.
Nitrogen as nitrates	5 parts per million.
Poisonous metals	Nil.

These figures indicate a water passable for domestic purposes.

For other analyses of water at Moggerhanger, *see* Dr. G. S. Buchanan's Report to Local Government Board, 1897.

Oakley.

Communicated by the Local Government Board.

1. Well at Bedford Rural District Council ISOLATION HOSPITAL.

Source. Well 45 feet and boring 45 feet, in Lower Oolites, under "Kellaways Sand," water from which was kept out by iron cylinders.

(N.B.—The material met with in the well was a dark shale, containing abundant well-preserved shells of *Ostrea Sowerbyi.*)

By Dr. Bernard Dyer. July, 1899.

	Results in grains per gallon.
Total dissolved matter	76·44
Loss on incineration of residue	5·88
Chlorine in Chlorides	6·10
(Equal to Chloride of Sodium)	(10·05)
Nitrogen in Nitrates	Inappreciable
(Equal to Nitric Acid)	(———)
Free (actual or saline) Ammonia	·038
Albuminoid (organic) Ammonia	·004
Oxygen absorbed by Oxidisable Organic matter, etc., from a solution of Permanganate of Potash at a temperature of 80° Fahrenheit:	
In 15 minutes	·027
In 4 hours	·054
Phosphoric Acid	Faint traces.
Appearance in 2 feet tube	Turbid, pale yellow.

I regret to have to report that, in my opinion, this is not a proper water for a public supply. Its bacterial condition is such as to leave no doubt in my mind that, even though the well may be deep the water pumped from it contains an admixture of what has very recently been surface water. The Specific Character, as well as the number of microbes present is sufficient to give significance to the high proportion of Chlorides and also to the high proportion of Ammonia, though the latter alone would not be necessarily significant in a deep well. Apart from the question of organic purity, the water is very hard, and unsuitable for general domestic purposes. It has a hardness of nearly 40 degrees, and even on boiling this is not reduced below 20 degrees. The total saline matters, in addition to 30 grains of Sulphate and Carbonate of Lime, include 14½ grains per gallon of Sulphate of Magnesia, and 11½ grains per gallon of Sulphate of Soda (equal to over 50 grains per gallon of Crystallised Epsom and Glauber's Salts) the presence of which would not be desirable in a public drinking water supply.

2. "SPRING" NEAR ISOLATION HOSPITAL of Bedford Rural District Council.

Source – Shallow well 8 feet in surface soil or drift.

By Dr. Bernard Dyer, July, 1899

	Results in grains per gallon.
Total dissolved matter	85·68
Loss on incineration of residue	3·36
Chlorine in chlorides	2·90
(Equal to Chloride of sodium	4·78
Nitrogen in nitrates	inappreciable
(Equal to nitric acid)	(——)
Free (actual or saline) Ammonia	·004
Albuminoid (organic) Ammonia	·006
Oxygen absorbed from a solution of Permanganate of Potash at a temperature of 80° Fahrenheit:—	
In 15 minutes	·889
In 4 hours	1·000
Phosphoric acid	faint traces
Appearance in 2 ft. tube	pale yellow; turbid

This water contains an abundance of surface bacterial life and other surface organisms, and would require very thorough systematic filtration before it would be organically fit for drinking purposes. Even then the great quantity of dissolved matter, though it might be tolerated for a private supply by anyone willing to face the inconvenience due to it, renders the water unfit for making a good public supply. It contains 18½ grains of carbonate of lime, and nearly 52 grains of sulphate of lime per gallon, the total hardness being over 60 degrees the hardness even after boiling being 45 degrees. Such water would constantly fur up pipes, boilers and kettles, and would be impracticable to wash with, without the plenteous use of soda. But it contains no appreciable quantity of purgative salts, and if thoroughly and systematically filtered would not be injurious to health. A curious feature in the analysis of the water is the very large quantity of oxygen absorbed by it from permanganate. This is not due to organic matter, but to the presence of an imperfectly oxidised sulphur salt, derived—possibly by bacterial agency—from the sulphurates present, and reconverted into sulphates by aeration and filtration.

Pulloxhill.

From Well at VICARAGE.
Communicated by Dr. Holland, Ampthill, to Mr. Cameron.
Results in grains per gallon

Dissolved solids dried at a temperature of 212° F.	65·800
Ammonia obtained from Ammonium salts	0·052
Ammonia from animal and vegetable substances	·036
Chlorine as chlorides	5·451

Nitrites. These were present at the time of receiving the sample, the amount was less on the second day.
Colour—fairly good.
Appearance—slightly opalescent.

The sample is of second class quality and not above suspicion.

Renhold.

Made and communicated by Dr. J. C. Thresh.
Well in Middle Oolite, at BRICK FIELDS. 50 feet deep.
One mile east of Goldington Church and ¼ mile north of Risinghoe Castle.
Ca 10·6, Mg 4·85, Na 39·35, K 3·5, CO_3 19·5, SO_4 78·3, Cl 16·7, NO_3 ·25.

	Results in parts per 100,000.
Calcium carbonate	26·5
Magnesium carbonate	5·05
Magnesium sulphate	16·8
Potassium sulphate	7·8
Sodium sulphate	89·6
Sodium chloride	27·55
Sodium nitrate	·35
Silica, etc.	·15
Total solids by direct weighing	173·8

Hardness 40°, Free Ammonia 0·001, Organic Ammonia 0·004, Oxygen absorbed n 3 hours at 98° F. 0·018, Nitrites absent.

Sandy.

Well at LORD NELSON, Public-House. In river gravel.
Analysis communicated by Dr. J. C. Thresh.

Chlorine in chlorides	4·6	grains per gallon
Nitrogen in nitrates	2·32	” ”
Total hardness	27°	
Free ammonia	0·06	part per million
Organic ammonia	0·40	” ”

Shalton.

Well at TEMPSFORD POST OFFICE.
Sunk in river gravel.
Analysis communicated by Dr. J. C. Thresh.

	Results in grains per gallon.
Chlorine in chlorides	4·6
Nitrogen in nitrates	2·03
Total hardness	25°
	Part per million.
Free ammonia	·01
Organic ,,	·09

Shefford.

CLIFTON LOCK, 1½ miles east of Shefford.

By Messrs. Savory and Moore. 1892.

The sample from No. 1 Bore pipe was somewhat turbid and had a slight deposit containing iron. The sample from the river was also somewhat turbid and had a slight deposit containing vegetable débris, living organisms and traces of iron.

	Parts per million.	
	No. 1 Bore pipe.	River opposite (No. 2).
Chlorine	18·	20·
Nitrogen as nitrites	—	Trace.
Nitrogen as nitrates	1·6	2·47
Ammonia	·2	·175
Total solids	325·	442·5
Total hardness	15°·75	17°·5

The residue on evaporation from the river sample was yellow, darkening considerably on ignition; that from the bore pipe was yellow, darkening to a less extent on ignition.

It will be noticed that the amount of ammonia is excessive in both samples 1 and 2. We think it extremely probable from this that the bore-hole taps the river water. The amount of nitrates and total solids is less in No. 1 than in No. 2, and this we think is due to the admixture of water drawn from the contiguous strata.

Southill.

AVENUE WELL.

Analysis by Messrs. Savory and Moore.
143, New Bond Street,
London, W. Sept. 7, 1892.

Water was slightly turbid and on standing deposited a light brown sediment containing iron, the supernatant water being clear and bright.

The water contained as follows:—

	Parts per million.
Chlorine	27
Nitrogen as nitrates	faint traces
Nitrites	0
Ammonia	0·015
Total solids	337·5
Hardness.	Degrees (Clark's Scale).
Permanent	5·77
Temporary	9·28
Total	15·05

The clear water was found to be quite free from traces of iron. Left in contact with the metals Lead or Zinc for several days the water had no solvent or other appreciable action upon them.

We consider this water to be of excellent quality, and in every way suitable for drinking and other domestic purposes.

Totternhoe.

Analyses communicated by Dr. J. C. Thresh.

1. MILL STREAM, polluted.

	Grains per gallon.
Chlorine in chlorides	2·8
Nitrogen in nitrates	·02
Total hardness	30°
	Parts per million.
Free ammonia	17·4
Organic ammonia	2·32
Oxygen absorbed: 15 minutes at 212° F.	4·74

Said to have been polluted at the time by sheep washing.

2. MILL STREAM, unpolluted.

	Grains per gallon.
Chlorine in chlorides	1·2
Nitrogen in nitrates	·6
Permanent hardness	5°
Temporary „	6°
	Parts per million.
Free ammonia	0·02
Organic ammonia	0·08

Woburn.

Analyses of water from the DAIRY WELL, PARK FARM, Woburn. By Dr. A. Voelcker.

Information from Mr. T. Preston to Mr. A. C. G. Cameron.

	1882.	1883.
Grains per gallon of solid constituents dried at 130°	53·2	54·6
Oxidisable organic matter	4·48	1·27
Chloride of sodium	9·22	10·48
Nitric acid	2·1	
Actual saline ammonia	·004	·006
Organic albuminoid ammonia	·004	·008
Hardness	40°	24·8°

In the earlier analysis the solid matter is said to consist chiefly of carbonate and sulphate of lime, in the later principally of the sulphate.

The well is isolated from all buildings but the Dairy ; so that pollution by sewage is not likely. But the water smells and is not fit for dairy use. Mr. Cameron suggests that the presence of selenite and iron-pyrites in the Oxford Clay may account for the smell and for the amount of lime-salts. Dr. Voelcker did not condemn the water as actually unwholesome, though advising that it should not be used.

ANALYSES OF WATERS.

NORTHAMPTONSHIRE.

NOTES ON NORTHAMPTONSHIRE WATERS.

By Beeby Thompson, F.G.S., F.C.S.

Northamptonshire waters may collectively be described as hard, taking the term "hard" to mean over 16°. The hardness is a natural consequence of the calcareous nature of the water-bearing beds in the Great and Inferior Oolite and the Middle Lias. Northampton Sand waters may be harder than those from contiguous Great Oolite, owing to the greater permeability of the Ironstone rock as a whole, whereby the water is brought into contact with a much larger surface of carbonate of lime, but of course this depends upon the condition of the Ironstone beds. In westerly parts of the county where the Ironstone beds are much more sandy and less calcareous, a fairly soft water may be obtained from them, as some of the quoted analyses show (*cf.* Blakesley).

Petrifying Springs.

A so-called "petrifying" spring is no curiosity in Northamptonshire, for the hardness spoken of above is generally in large measure due to the presence of bicarbonate of lime in the water; that is to say the hardness is largely temporary, and given suitable conditions for the release or absorption of the feebly combined carbonic acid gas which holds the otherwise insoluble carbonate of lime in solution, the latter substance is precipitated on any solid body present. Increase of temperature on flowing as a shallow stream, and splashing or spraying of the water on to objects, will release the carbonic acid gas, whereas growing vegetation will absorb it and consequently get coated with carbonate of lime.

Morton[1], even, thought the number of petrifying springs too numerous to specify as "we have hundreds of them in this single county." One, perhaps, deserves record here as the best the writer has come across, judging by results. On digging round the old open cistern enclosing the Broadley Head Spring, in Abington Park, Northampton, in order to put in a new wall, and in making a culvert near to it about five years ago quite a large amount of calcareous tufa was cut through; some was pure white and some cream-coloured, all highly vesicular, and containing abundant and very perfect casts of leaves and stems of vegetation. The wheel in the pump-house near is coated with carbonate of lime. The Northampton Sand from which this water comes is, hereabouts, largely crystallized carbonate of lime, derived from original coral.

Chalybeate Waters.

Iron may be present in waters as ferrous bicarbonate, ferrous sulphate, and crenate and apocrenate of iron, but in all cases the iron, or most of it, is gradually deposited as a red sediment, if the water stands for a time exposed to the air.

The bicarbonate of iron is of course ferrous carbonate dissolved in carbonic acid, and like calcium carbonate is precipitated under such circumstances as cause the loss of carbonic acid gas from the water.

Ferrous sulphate is the most likely soluble iron compound to be formed in a water-bearing rock, but the least likely to be found in the water, for the following reasons:—That easily decomposed form of iron pyrites known as marcasite, so commonly present in rocks, forms, on oxidation, ferrous sulphate and free sulphuric acid. The free sulphuric acid combines with the alkaline earth bases, such as lime and magnesia, to form sulphates, probably decomposing carbonates of these bases in order to do so, and so setting free carbonic acid gas. The ferrous sulphate may then, and particularly so under pressure, change, firstly into ferric sulphate and then into limonite or hydrated ferric oxide, which mineral is insoluble in ordinary water. But if the iron is not got rid of in this way, it is likely to be precipitated as carbonate by soluble carbonates or bicarbonates of other bases present in the water, to be partly re-dissolved again by the excess of carbonic acid, thus giving the soluble bicarbonate of iron.

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[1] The Natural History of Northamptonshire (1712).

Notwithstanding the possibility of iron being found in waters from the above-named causes, in most cases where a water deposits a red sediment on exposure to the air, it is due to the decomposition of an unstable organic salt of iron, originating in the solution of iron by the organic acids formed by decomposing organic matter.

The writer could give numerous instances of such Chalybeate waters intimately connected with actual bogs (*cf.* Woodford Halse) or running as shallow springs under vegetable soils, that is to say uncultivated soils largely composed of the decaying vegetation of previous seasons, as in plantations or woods. Hence the idea is engendered that the large number of Chalybeate waters mentioned by Morton as occurring in Northamptonshire 200 years ago, was due to deficient drainage at that period ; in fact that they were mostly bog springs, as some of them certainly were.

It is well known that the water of lakes or reservoirs having relatively large shallow margins will often, in the autumn, become charged with organic salts of iron ; the reservoir at Ravensthorpe, supplying Northampton, gets so. The explanation is simply that the marginal mud is ferruginous, and that when the abundant shallow water vegetation begins to decay the resulting organic acids dissolve the iron.[1]

Furthermore, some deep-seated waters, usually quite clear and without sediment, will, at the latter end of the year, give deposits containing iron ; this the writer regards as a fairly sure indication that the water-bearing rock is stream-fed, at no great distance away. This is a point of some importance, and apparently the phenomenon recorded has not been so interpreted before.

SALINE WATERS.

With the exception of the deep-seated Trias waters (*see* Kingsthorpe) there are no true saline waters in Northamptonshire. If the analysis of a water from any spring or well shows more than 60 grains of solid matter to the gallon it is either polluted or has been stagnant in the rock for long periods. Not uncommonly a newly-tapped source of water may yield as much as 250 grains per gallon of solid matter, and when this is the case sulphates are abundant, calcium sulphate perhaps being present to the point of saturation. (*cf.* Hannington—Tea Caddy Farm). The interpretation to be put upon such a water is that the decomposition of marcasite in the rock has provided the sulphuric acid (as described under Chalybeate waters) for the formation of sulphates, and that there has been no renewal of the water ; the inference to be drawn is that if the yield of water is fairly large it will gradually improve in quality, with pumping, to that normally yielded by the same bed in the same area (*cf.* Upper Heyford). There are no unpolluted freely running springs anywhere in the county yielding waters of the character described above.

Springs contaminated with sulphuretted hydrogen due to the decomposition of pyrites have been met with from time to time in well-sinking, as at Blatherwycke, south-west of Kings Cliffe (junction of Northampton Sands and Upper Lias), and at other localities mentioned in the following pages.

Holy Wells have been recorded at Boughton (Boughton Field, near Brampton Bridge), Barnwell (Seven Wells), Oundle (Drumming Well), and Peterborough (St. Laurence's Well).[2]

The following is a list of the principal Mineral Springs that have been recorded in Northamptonshire :—

Chalybeate and Saline Chalybeate.

ASTROP SPA, near King's Sutton	Lower beds of Middle Lias.
BARBY, Road well	Lower beds of Middle Lias.
BUGBROOK	Middle Lias.
BURGHLEY PARK	Northampton Sands.

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[1] Other ailments of water arise from shallowness. *See* "Reservoirs," by Beeby Thompson. *Journ. North. Nat. Hist. Soc.*, Dec., 1898.

[2] R. C. Hope, "Holy Wells of England," 1893, pp. 99, 100.

Chalybeate and Saline Chalybeate.—*continued.*

East Haddon	Northampton Sands.
Eydon	Northampton Sands.
Farthinghoe, Red well	Northampton Sands.
Higham Ferrers	Northampton Sands.
King's Sutton, Sutton Bog	Middle Lias.
Nobottle, between Floore and Harlestone	Northampton Sands.
Stanwick	Northampton Sands.
Thenford	Middle Lias.
Warmington, Chadwell.	
Weedon Lois, St. Loy's spring	Northampton Sands.
Wellingborough, Red well	Northampton Sands.
Wittering Spa	Northampton Sands.

Petrifying.

Brigstock	Great Oolite.
Brixworth	Northampton Sands.
Maidwell	Northampton Sands.
Old or Wold, Oak spring	Northampton Sands.
Pytchley	Great Oolite.
Raunds	Great Oolite.
Rothwell	Northampton Sands.

Blakesley.

1. Trial Well.

By Mr. J. Bingley, F.C.S., April, 1901.

	Parts per million.
Free ammonia	trace
Albuminoid ammonia	·04
	Grains per gallon
Chlorine in chlorides	·8
Nitrites	none
Nitrogen in nitrates	·4
Hardness.	Degrees.
Temporary	8
Permanent	5
Total	13
Total solid matter dried at 212° F.	16
Lead	none.

"This water is of excellent quality for drinking and very suitable for a public supply."

2. Village Supply.

Spring.

By Dr. J. A. Voelcker, July, 1902.

	Results in grains per gallon.
Free ammonia	·001
Albuminoid ammonia	·002
Chlorine	·86
Equal to sodium chloride	1·42
Nitric acid	1·29
Oxidisable organic matter	·09
Total solid residue, principally of lime salts, the water being a somewhat hard one	30·8

Water colourless, but with a little cloudy deposit which gradually settled down.

"Quite a good supply for drinking purposes."

Brackley.

1. Deep Well, water from the Marlstone.
(Previous to 1890.)

Communicated to Mr. Beeby Thompson by Mr. Thomas Judge.

Analysis by the late Dr. Letheby.

	Grains per gallon.
Actual or saline ammonia	0·014
Ammonia from organic matter	0·005
Nitrogen as nitrites	trace.
Carbonate of lime	7·71
Carbonate of magnesia	2·40
Carbonate of soda	16·67
Sulphates of lime and magnesia	1·83
Sulphate of soda	33·55
Chloride of sodium	20·06
Silica, alumina, oxide of iron	0·59
Organic matter	0·19
	83·19

Degree of hardness - - - - 8·0
" " " - - - - 2·4 after boiling quarter of an hour

2. Water from Shallow Wells in or upon the Oolites.

Sixth Report of the Rivers Pollution Commission, pp. 80, 81, 1874.

—	Mr. Weston's Well. July, 1871.	Mr. Howard's Well. July, 1871.	Rev. Smith's Well. July, 1871.	Mr. Ramsey's Well. July, 1871.	The Vicar's Well. August, 1871.
	Results in parts per 100,000.				
Total solid impurity	121·60	84·88	100·80	66·68	70·80
Organic carbon	2·662	·203	·277	·237	·307
Organic nitrogen	·531	·085	·063	·077	·083
Ammonia	·034	—	·005	·002	·002
Nitrogen as nitrates and nitrites	3·801	4·432	4·953	2·019	1·744
Total combined nitrogen	4·360	4·517	5·020	2·098	1·829
Previous animal contamination	37·970	44·000	49·250	19·890	17·140
Chlorine	13·50	7·90	10·70	6·20	3·80
Hardness :—					
Temporary	30·7	10·8	25·0	24·4	42·2
Permanent	22·2	33·5	29·3	16·3	20·6
Total	52·9	44·3	54·3	40·7	62·8
Remarks	Very brown and turbid.	Very slightly turbid.	Very turbid.	Turbid.	—

Brafield.

Well.

By Mr. Joseph Young, 1902.

Communicated by the Local Government Board.

	Parts per Million.
Free ammonia	·028
Albuminoid ammonia	·05
Nitrogen from nitrates and nitrites	·39
	Grains per gallon.
Chlorine as chlorides	1·01
Nitrites (NO_2)	None
Oxygen required to oxidise organic matter	—
Solid constituents	66·85

Well—*continued.*

Hardness.	Degrees. (Dr. Clarke's Scale.)
Temporary	10·36
Permanent	30·52
Total	40·88
Metals	None.

Appearance at 24 inches deep.—Colourless, slightly turbid.

Ten degrees of hardness, representing carbonate of lime, may be removed by boiling, leaving 30 degrees due to sulphate of lime. These proportions are somewhat high for a public supply, but the water is quite free from sewage contamination, and may be used with perfect safety for drinking purposes.

Brigstock.

Communicated by Mr. Beeby Thompson.

1. RED SPRING.

At a slightly lower level than any of the well water sources (about 166 feet above Ordnance Datum) is a spring running into the Harper Brook, nearly at brook level, from a kind of limestone gravel, which deposits a red sediment. The source of the water is uncertain, but it is distinctly chalybeate. It has a slightly inky taste, gives a dark colouration with brandy, and is valued for making tea in consequence of the dark colour it gives to the infusion.

2. WELLS and BROOK.

—	New Well August, 1901 Beeby Thompson.	New Well December 1901, after exhaustive pumping. Dr. Voelcker.	Harper Brook January, 1902. Beeby Thompson.
	Grains per gallon.		
Free Ammonia	·0014	.005	.006
Albuminoid Ammonia	·0017	·005	·005
Oxygen absorbed by oxidisable organic matter	—	·047	—
Total oxygen absorbed at 100° C	·084	—	·252
Chlorine	1·3	1·26	1·4
Hardness—Temporary	23·5	—	—
,, Permanent	1·5	—	—
,, Total	25·0	34·00	20·1
Total solid residue	29·5	47·88	29·7

Probable composition of the solid residue, August sample, from quantitative analysis by Mr. Beeby Thompson :—

	Grains per gallon.
Alumina and ferric oxide	2·34
Silica	·09
Calcium carbonate	21·50
Magnesium carbonate	1·20
Calcium sulphate	2·04
Sodium chloride	2·14
,, nitrate	·14
,, sulphate	?
	29·45

3. WELL in Oolite.

Communicated by Dr. J. C. Thresh.

	Results in grains per gallon.
Free ammonia	0·0007
Organic ammonia	0·0007
Oxygen absorbed (4 hours 80° F.)	Nil.
Nitrogen as nitrates	0·025
Chlorine as chlorides	7·4
Iron	Trace.

3. Well in Oolite—*continued.*

Hardness.	Degrees.
Temporary	10
Permanent	23
Total	33

Bringtou.

Middle Lias well water, below Rock-bed.

Communicated by Mr. Beeby Thompson.

Analysis by Dr. W. L. Emmerson.

Appearance in two-foot tube	Clear.
Smell when heated to 100°	None.
Microscopical examination	No deposit.
	Grains per gallon.
Oxygen absorbed in two minutes at 80°	·0065
Solids	43·15
Chlorine	1·10
Free ammonia	·0039
Albuminoid ammonia	·0023
Hardness in degrees	16·5

This is a very good water, and fit for all domestic purposes.

Burton Latimer.

Northampton Sand Waters.

Analyses by Mr. Beeby Thompson, F.G.S., F.C.S.

—	The Spring.	Bolton's pump.	Stockwell pump.	Mr. Barlow's.	Piggott's Lane.
	Parts per million.				
Free ammonia	·018	·072	·018	·532	·040
Albuminoid ammonia	·014	·020	·014	·030	·030
Total oxygen absorbed at 100° C.	1·000	1·400	1·000	1·400	1·400
	Grains per gallon.				
Chlorine	3·2	4·9	2·3	2·8	8·1
Solid residue	46·5	53·	16·	38·5	78·
Hardness as calcium carbonate = degrees.	17·	19·4	7·5	20·7	26·3
Appearance	Bright and clear.	Bright and clear.	Bright and clear.	Bright and clear.	Bright and clear.
Odour at 65° C.	None.	Faint.	None.	Slight.	Slight.
Sediment—microscopic examinations.	Small—only mineral.	Trifling, mineral and a few vegetable cells.	Trifling, mineral and vegetable cells and fibrils.	Small; more than 1, 2, and 3 mineral and vegetable.	Small; similar to others.
Solid residue composition and remarks.	White, largely carbonates.	Brownish; some iron.	Some iron; not wholly Northampton sand water?	Brownish: Much free CO_2; milkiness at 65° C.	Slightly yellow; contains iron; much milkiness on boiling.

Cold Higham.

Source.—Spring from red sandstone (Northampton sand) at GRIMSCOTE: said never to fail.

Yield 46 gallons per minute.

By Mr. A. Bostock Hill. 1895.

Communicated by the Local Government Board.

	Results in parts per 100,000
Total solid impurity	48·
Free ammonia	·016
Organic ammonia	·009
Nitrogen as nitrates and nitrites	Trace.
Total combined nitrogen	—
Oxygen absorbed in four hours	—
Chlorine	1·8
Hardness.	
Temporary	22·4
Permanent	12·0
Total	34·4

Water, bright with a few small particles.

Daventry.

1. Analysis of a sample of water from a trial boring at MONKSMOOR.

Gravel and Sand Beds.

By Mr. John Bingley, Junr.

Communicated by Mr. J. B. Williams, Daventry, 1896.

		Parts per million.
Free ammonia		·032
Albuminoid ammonia		·036
		Grains per gallon.
Chlorine as chlorides		·9
Nitrites		None.
Nitrogen as nitrates		·188
Temporary hardness	12·6	
Permanent ,,	6·4	
	19·0	
Total solid matters dried at 212° F.		34
Lead		None.

The above data indicate that the water is of excellent quality. The temporary hardness is rather high.

2. Well. Near HOSPITAL on ASHBY ROAD.

Water from Middle Lias? or Drift?

Analysis by Mr. Beeby Thompson. 1893.

This water was said to smell very badly when first drawn (Sulphuretted Hydrogen?), but the odour went off in a short time; it also came up dark-coloured after a long interval from previous pumping. The water was alkaline, and the sedimentary matter filtered out of it was quite red.

Analysis of filtered water:—

	Parts per million.
Free ammonia	·48
Albuminoid ammonia	·03
Total Oxygen absorbed at 100°C.	1·40
	Grains per gallon.
Chlorine	0·8
Hardness expressed as calcium carbonate	37·0
Total solid residue	63·0

A quantitative analysis gave, Fe_2O_3, 15·4; CaO, 6·0; MgO, 3·77; Na_2O, 5·19; Cl, 0·8; NO_3, ·124; SO_3, 15·51; CO_2, 16·37, from which it may be perceived that the CO_2 was not adequate to hold the carbonates of Fe, Ca and Mg in solution, in the form of carbonate, consequently the iron must have been partly in solution, combined with some organic acid or acids, which will account for other peculiarities of the water.

Denton.

Source—WELL, 78 feet, in Lower Oolites. Water level 61 feet below surface.
Yield, 28,600 gallons per diem.
Analysis by Mr. W. L. Emmerson, October, 1900.
Communicated by the Local Government Board.

Water from New Well.

Appearance in two-foot tube	Clear, very pale yellow.
Smell when heated to 100°	None
Microscopical examination	No sediment, animalculæ.
	Results in grains per gallon.
Free ammonia	·0031
Albuminoid ammonia	·0021
Oxygen absorbed in ¼ hour at 212°	17
Solids	48
Loss on incineration (does not char)	9
Chlorine	3
Hardness in degrees	37°

Nitrites absent; Nitrates, a trace.
Sulphates, traces; Iron, faint trace.

"This water is of good quality for domestic use, and gives no evidence of contamination. It is exceedingly hard."

Dodford.

Source.—WELL 38 feet in Middle Lias, the chief supply of water coming from a bed of rock at 20 feet depth, into which headings were driven. Yield 5,000 gallons per hour in February, 1902.

Analysis by Mr. J. Bingley, F.C.S., November 29th, 1901.
Communicated by the Local Government Board.

	Parts per million.
Free ammonia	None.
Albuminoid ammonia	·03
	Grains per gallon.
Chlorine in chlorides	·9
Nitrites	None.
Nitrogen in nitrates	Trace.
Hardness.	Degrees.
Temporary	10
Permanent	7
Total	17
Total solid matter dried at 212° F.	28·
Lead	None.

"Water is of excellent quality for drinking and general domestic purposes and quite suitable for a public supply."

Earls Barton.

Source—Debdale Spring, Great Doddington.
Spring from Northampton Sand.
Yield, 13,000 gallons in 24 hours, in May, 1899, but subsequently diminished.

1. Analysis by Dr. E. W. Voelcker. October, 1898.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	25·76
Free ammonia	·0015
Albuminoid ammonia	·0017
Oxidisable organic matter	·09
Lime	11·34
Magnesia	·53
Sulphuric acid	2·14
Nitric acid	1·34
Chlorine	1·29
Equal to chloride of sodium	2·13

Water colourless, but contained a little earthy deposit. On evaporation to dryness left a residue amounting to 25·76 grains per gallon, consisting largely of carbonate of lime with some sulphate of lime.

The water is a hard one, and consequently not convenient for general domestic use. It is, however, very free from organic impurity and should be a perfectly good water for drinking use.

2. Analysis by Dr. E. W. Voelcker. June, 1899.

	No. 1. Debdale Spring.	No. 2. West Hill Spring.
	Grains per gallon.	
Total solid residue	29·96	30·52
Free ammonia	·001	·0015
Albuminoid ammonia	·002	·003
Oxidisable organic matter	·08	·08
Nitric acid	1·02	1·23
Chlorine	1·21	1·41
(Equal to chloride of sodium)	1·99	2·32
Lime	13·02	13·38

Both waters were colourless and free from deposit. The analytical results are closely alike, No. 1 being the better of the two. The two waters are of a distinctly hard character, containing as they do about 30 grains per gallon of total solid residue, consisting mainly of carbonate of lime with a little sulphate of lime and magnesia. They contain, however, but little dissolved organic impurity.

East Haddon.

Analysis of public water-supply by Dr. W. L. Emmerson, (published in Dr. R. B. Low's Report on Long Buckby, 1896).

	Results in grains per gallon.
Oxygen absorbed in 2 minutes at 80°	·0115
Chlorine	6·10
Free ammonia	·0045
Albuminoid ammonia	·006

The water was clear and although not free from organic matter was within the limits allowed for potable water.

Etton.

1. PUBLIC SUPPLY from boring at Etton, for Peterborough.

Made and communicated by Dr. J. C. Thresh.

	Results in parts per 100,000.
Free ammonia	·020
Albuminoid ammonia	·0064
Oxygen absorbed (4 hours 80° F.)	·0131
Total solids	50·9
Calcium carbonate	20·25
Magnesium carbonate	3·5
Sodium carbonate	5·05
Sodium sulphate	10·35
Sodium chloride	8·9
Sodium and potassium nitrate	·35
Silica, etc.	2·5
Hardness.	Degrees.
Temporary	20
Permanent	4
Total	24

2. Waterworks.

Source. Artesian Boring (No. 1) Six inches in diameter and 139 feet deep, from Cornbrash to Lincolnshire Limestone.

Yield 211,320 gallons per day.

Water rises 26 feet above the surface of the ground (25·3 feet above Ordnance Datum.)

Analysis by Mr. W. Elborne, November 1901.

Communicated by the Local Government Board.

Yield of free ammonia	0·0034
Yield of albuminoid ammonia	0·0017
Chlorine	2·62
Nitrates and nitrites	absent
	Result in grains per gallon.
Carbonate of lime	16·70
Carbonate of magnesia	0·80
Chloride of soda	4·35
Sulphate of lime	3·15
Silica	0·25
Total	25·25
Total Hardness	16½ degrees.
Hardness after boiling	7½ ,,

"A water of great purity, very good for all drinking purposes and suitable for a public supply. It is 3½ degrees softer than Braceborough water and blends with it perfectly."

3. Source. Boring No. 2, 12 inches in diameter and 144 feet deep to Lincolnshire Limestone.

Yield 172,440 gallons daily: water rising 26 feet above the surface of ground.

Analysis by Mr. W. Elborne, July, 1902.

Yield of free ammonia	0·0034
Yield of albuminoid ammonia	0·0017
Chlorine	2·97
Nitrates and nitrites	Absent.
Silica and oxide of iron	traces.
	Results in grains per gallon.
Carbonate of lime	10·75
Carbonate of magnesia	4·20
Carbonate of soda	3·50
Chloride of soda	4·93
Sulphate of lime	1·82
Total	25·20
Total hardness	17 degrees.
Hardness after boiling	4 ,,

"A water of very good quality suitable for a public supply. Of identical organic purity when compared with the water from the original bore (judged by the analysis of the latter, made in November last); furthermore, while the total quantity of constituents per gallon remains the same, their character however, has undergone a slight alteration but of no material significance, and in no way impairing the quality of the water either for drinking and domestic purposes, or for a public supply."

Source. Boring No. 3, 6 inches in diameter, and 142 feet deep, into Lincolnshire Limestone.

Yield 777,320 gallons daily, water rising 26 ft. above level of ground.

Analysis by Mr. W. Elborne, 1902.

Yield of free ammonia	0·02
,, ,, albuminoid ammonia	0·0019
,, ,, chlorine	3·5
Nitrates and nitrites	Absent.
Silica and iron oxide	traces

	Results in grains per gallon.
Carbonate of lime	15·50
Carbonate of magnesia	2·10
Carbonate of soda	1·86
Chloride of sodium	5·80
Sulphate of lime	1·24
Total	26·50
Hardness	16½ degrees.
Hardness after boiling	3½ „

A very pure excellent water suitable for a public supply, practically identical in quality and composition with Braceborough water, and blending with it perfectly.

Boring No. 3.

Analysis by Dr. J. C. Thresh.

	Parts per 100,000.
Calcium carbonate	20·25
Magnesium carbonate	3·5
Sodium carbonate	5·05
Sodium sulphate	10·35
Sodium chloride	8·9
Sodium and potassium nitrate	·35
Silica, etc.	2·5
Total solids	50·9
Permanent hardness	4 degrees.
Temporary ,,	20 degrees.
Free ammonia	·020
Organic ammonia	·0064
Oxygen absorbed (4 hours, 80° F.)	·0131

Finedon.

1. Source. Trial well.—114 ft. in Upper Lias clay, steined only with 4½ ins. dry brickwork.

Analysis by Mr. W. Elborne, 1900,

Communicated by the Local Government Board.

This water is perfectly sound, only it will be found too hard for "washing purposes." I am of opinion that the *total saline matter* will gradually diminish when the well is in working order, the present disturbance of the strata having caused more (abnormal) saline matter to become dissolved. The water would merit another analysis later on (if exception be taken to the present high figures of total solids and hardness).

	Results in grains per gallon.
Total solids in solution	224· [dried at 212°F.)
Degrees of hardness	63·
Chlorine	41·125
Equivalent to 68gns. of common salt (entirely of mineral origin however).	
Nitrites	absent
Nitrates	traces only.
Free ammonia	0·07
Albuminoid ammonia	0·008
Oxygen absorbed	0·065

This sample was received in a turbid condition; in 3 days it readily cleared (by subsidence) becoming quite bright and clear.

Water free from all organic contamination and in my opinion a good, wholesome drinking water, contains a good deal of harmless saline matter in solution derived from the strata, thus rendering the water exceedingly hard.

2. Source. Well 125 feet deep and heading in Marlstone, under Upper Lias clay. Nearest outcrop of Marlstone 15 miles distant.

Yield 100,000 gallons per diem in December, 1900. Well with steining of 9 inch brickwork in cement; about 12 yards distant from the former trial well.

Analysis by Mr. W. Elborne. 1901.

Free ammonia	0·05
Albuminoid ammonia (none)	0·00
Nitrites and nitrates (none)	0·00
Chlorine	63·00
	Results in grains per gallon.
Sodium chloride	104·00
„ carbonate	27·00
„ sulphate	14·00
Calcium carbonate	4·90
Magnesium „	3·10
Total	153·00
Total hardness	3¾ degrees.

"Water of first class purity, thoroughly wholesome and suitable for drinking and domestic purposes. The saline constituents are such that they impart 'softness' to the water. Suitable for public water-supply."

3. New Well.

First water, from the Communis limestone of the Upper Lias.

Analysis by Mr. Beeby Thompson. January 23rd, 1901.

	Parts per million.
Free ammonia	1·20
Albuminoid ammonia	0·12
Total oxygen absorbed at 100° C	1.10
	Grains per gallon
Chlorine	91·0
Hardness as calcium carbonate=degrees	7·0
Total solid residue	190·0
Chlorine (Jan. 25, 1901)	85·4

Gayton.

Source.—Spring in field No. 161, 25-inch Ordnance map, at junction of Northampton Sand and Upper Lias clay at altitude of 375 ft. above Ordnance Datum.

Yield.—23,600 gallons per 24 hours. August and September 1899.

Analysis by Mr. John Bingley, F.C.S. 1899.

Communicated by the Local Government Board.

	Parts per million,
Free ammonia	none.
Albuminoid ammonia	·06
	Grains per gallon
Chlorine in chlorides	1·1
Nitrites	none.
Nitrogen in nitrites	·46
Hardness.	Degrees.
Temporary	8
Permanent	8
Total	16
Total solid matter dried at 212° F.	24
Lead	none.

"Water of good quality for drinking and general domestic purposes."

Great Doddington.

Great Oolite Limestone water.

Two samples of fairly pure well water. Analyses by Mr. Beeby Thompson. 1902

	Parts per million.	
	(1.)	(2.)
Free ammonia	·04	·026
Albuminoid ammonia	·05	·070
Total oxygen absorbed at 100° C.	2·05	2·600
	Grains per gallon.	
Chlorine	2·4	3·3
Hardness	19·9	32·7
Total solid residue	40·0	43·0

Green's Norton.

Source.—Well 10 feet deep, at Junction of Oolite with Upper Lias Clay.
Yield, 2,500 gallons per hour.
Analysis by Mr. A. Bostock Hill.
Communicated by the Local Government Board.
Proposed supply for village.

Appearance in 2 foot tube	Slightly turbid.
Smell when heated to 100°	none.
	Grains per gallon.
Nitrogen as nitrates and nitrites	0·0
Total solids	40·6
Chlorine	1·12
Free ammonia	·0007
Albuminoid ammonia	·0028
Hardness.	Degrees.
Temporary	17·82
Permanent	7·40
Total	25·22

With the exception of being rather hard, the water is well suited for drinking and other domestic purposes, as it contains but little fresh organic matter, and is quite free from any past pollution.

Hannington.

TEA CADDY FARM.

Water from sandy or gravelly layers in Boulder Clay. 1906.
Analysis by Mr. Beeby Thompson, F.G.S., F.C.S.

	Parts per million.
Free ammonia	·164
Albuminoid ammonia	·050
Total oxygen absorbed at 100° C.	2·400
	Grains per gallon.
Chlorine	6·5
Hardness as calcium carbonate	192·0
Total solid residue	240·5

The hardness is nearly all permanent. The water is practically a saturated solution of calcium sulphate, which substance begins to be thrown down as soon as the water is boiled.

Other samples gave :—
Small spring in chalky gravel at 60 feet down, 249 grains per gallon.
Sample of water from the bottom of the well, 261·5 grains per gallon.

Approximate composition of the solid residue :—

Alumina, etc.	5·46
Sodium chloride	10·75
Sodium sulphate	24·94
Calcium carbonate	17·25
Calcium sulphate	136·62
Magnesium carbonate	19·48
Magnesium sulphate	47·00
Total	261·50

Hardingstone.

Public Water Supply. Source Northampton Sand.

Analysis by Mr. Lawrence Briant, 1898.

	Parts per million.
Free ammonia	Nil.
Albuminoid ammonia	·055
Oxygen required to oxidise organic matter	·740
	Grains per gallon.
Total solid residue, dried at 212° F.	34·16
Saline residue	32·76
Organic and volatile matter and water of crystallisation	1·40
Lime	14·03
Magnesia	0·91
Soda	1-86
Potash	0·89
Sulphuric acid	4·32
Nitric acid	Nil.
Nitrous acid	Nil.
Chlorine	1·54
Poisonous metals	Nil.
Iron	Trace.

Probable constitution of the Saline Residue in grains per gallon :—

Chloride of sodium	2·54
Sulphate of soda	1·17
Sulphate of potash	1·65
Sulphate of lime	4·91
Carbonate of lime	21·44
Carbonate of magnesia	1·91

Hartwell.

1. Present Source. ? Spring.

Analysis by Dr. E. W. Voelcker, County Analyst. 1903.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	46·76
Free ammonia	none.
Albuminoid ammonia	·0015
Oxygen absorbed by oxidisable organic matter	·015
Nitrogen as nitrates	·265
Equal to nitric acid	1·02
Chlorine	3·19
Equal to chloride of sodium	5·26

An extremely hard water, and not a really satisfactory supply.

2. Proposed source.

Analysis by Dr. E. W. Voelcker. 1903.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	36·68
Oxygen absorbed by oxidisable organic matter	·026
Nitrogen as nitrates	·218
Equal to nitric acid	·84
Chlorine	1·57
Equal to chloride of sodium	2·59
Free ammonia	trace.
Albuminoid ammonia	·003

A very hard water, and only fairly satisfactory.

Irchester.

CATTLE LANE, water from well in Northampton Sand.

——	Dr. Voelcker 1st 1904.	Dr. Voelcker 2nd 1905.	Mr. Beeby Thompson 1905.
Free ammonia	·002	·001	·003
Albuminoid ammonia	·005	·006	·005
Oxygen absorbed by oxidisable organic matter	·048	·064	—
Nitrogen as nitrates	4·64	5·41	—
Equal to nitric acid	17·92	20·86	—
Chlorine	6·29	9·12	9·4
Equal to chloride of sodium	10·35	15·01	15·5
Hardness	—	—	37·2
Total solid residue	81·20	94·64	96·3
			Chlorides, Sulphates, Carbonates and Nitrates in unusually large quantities.

Irthlingborough.

Source. Well 78 feet deep in Northampton Sand.

Analysis by Mr. F. W. Richardson, 1902.

Communicated by the Local Government Board.

Appearance—Colourless and transparent.

	Results in grains per gallon.
Total solid matters	58·0
Free ammonia	none
Albuminoid ammonia	·0035
Organic and volatile matters	8·0
Mineral matters	50·0
Chlorine (combined)	1·8
Nitrites	none
Nitrogen as nitrates	do.
Absorbed oxygen (4 hours)	—
Lead	none
Total hardness	37·2
Temporary hardness	20·4
Permanent hardness	16·8

Organically this is very pure water, and shows no signs of even bygone or oxidised sewage pollution.

It is excessively hard, but over half the hardness is removable by boiling.

Kings Cliffe.

1. The BEE WELL.

Source. Shallow well in Northampton Sand, 132 feet above Ordnance Datum, overflowing 21,600 gallons in 24 hours in July 1900: said not to diminish in dry weather.

By Mr. J. West Knight, Public Analyst, 1898.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid matter	41·00
Ammonia (Free)	trace.
Ammonia (Albuminoid)	·0007
Chlorides	2·90

1. The BEE WELL.—*continued.*

	Results in grains per gallon
Equal to chloride of sodium (common salt)	4·77
Nitrates (expressed as nitrogen)	·60
Oxygen absorbed by organic matter in 15 mins. at 140° F.	·0140
Appearance in 2 foot tube	clear pale blue.
Smell when heated to 100° F.	none.
Metals	none.
Microscopic examination	no deposit.

Total solid matter, chlorides and nitrates are fairly low and quite satisfactory.

Free and albuminoid ammonia and oxygen absorbed are all very low and show the absence of organic matter.

I consider the water is unpolluted and quite fit for drinking purposes.

2. SPOUT HALL SPRING.

Source. Spring, under embankment of L. & N.W. Railway, from Northampton Sand, at 135 feet above Ordnance Datum. Yield (in July 1900), 59,040 gallons per 24 hours, said not to diminish in the driest seasons.

By Mr. J. West Knight, Public Analyst, 1898.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid matter	31·00
Ammonia (Free)	none.
Ammonia (Albuminoid)	·0007
Chlorides	1·50
Equal to chloride of sodium (common salt)	2·47
Nitrates (expressed as nitrogen)	·50
Oxygen absorbed by organic matter in 15 mins. at 140° F.	·0140
Appearance in 2 foot tube	clear pale blue.
Smell when heated to 100° F.	none.
Metals	none.
Microscopic examination	no deposit.

Total solid matter, chlorides and nitrates are low and quite satisfactory. Free and albuminoid ammonia and oxygen absorbed are very low and show the absence of organic matter.

The water is unpolluted and quite fit for drinking purposes.

3. The BREWERY WELL.

Source. Well 6 ft. deep in Northampton Sand, 134 ft. above Ordnance Datum. Overflows into the brook when pumping is not taking place.

By Dr. Cassall, October 1st, 1898.

Communicated by the Local Government Board.

Appearance in 2 ft. tube.—Fairly clear.—Faint greenish yellow tint.—Odour and taste—not abnormal.

Reaction—neutral.

	Results in parts per 100,000.
Total solids	68·0
Chlorine as chlorides	3·70
Chloride of sodium	6·09
Nitrogen as nitrates	1·00

	Results in parts per 1,000,000.
Oxygen absorbed from permanganate 30° C. 4 hours	1·093
Saline ammonia	0·008
Organic ammonia	0·056

Hardness :—	Degrees.
(*a*) Permanent	30·0
(*b*) Temporary	22·4
Lead, copper, iron	absent.
Appearance of solids on ignition	slight browning.
Microscopic examination of the suspended matter	a litte vegetable matter. a little mineral matter.
Nitrites	present.
Phosphates	slight traces.

November 21st, 1898.

	Results in grains per gallon.
Free ammonia	trace
Albuminoid ammonia	0·005
Oxygen absorbed in 1 hour	0·046
„ „ 3 „	0·057
Nitrogen as nitrates and nitrites	0·542
Equals nitric acid	2·44
Chlorine	2·94
Carbonic anhydride	10·56
Sulphuric „	2·56
Lime	14·56
Magnesia	1·28
Potassium	none
Sodium	1·90
Oxides of iron and aluminium	none
Silica	·98
Hardness before boiling	24·0
„ after „	8·0

Kingsthorpe.

Water from Trias.

Communicated by Mr. Beeby Thompson.

An analysis of the salt water from the Kingsthorpe Shaft, made by Mr. Gardner, of Oxford Street, London (1866 or before), was recorded as follows:

	grains.
Muriate of magnesia	4·0
Muriate of lime	8·0
Muriate of soda	69·5
Sulphate of soda	48·5
Total	130·0

In one wine pint of the water (presumably rather more than 1¼ pint actual.)

The above agrees fairly well with 387·6 grains of Chlorine per gallon from Kingsthorpe, and 349·7 grains of Chlorine per gallon from the Kettering Road, Northampton, Wells, recorded in 1881 (*Journ. Northampton. Nat. Hist. Soc.*, Vol. i., p. 224).

King's Sutton.

1. Astrop (or East-thorp) Spa; spring half a mile east of King's Sutton, was discovered in 1664 and afterwards enclosed in a well.

"Astrop was then in the height of its popularity, and could boast of its public ball every Monday, and breakfast, cards, dancing, and ordinary for ladies and gentlemen every Friday during the season."[1] In the latter half of the 18th century it went out of fashion.

The following analysis was made by Mr. T. Beesley in June, 1850.[2] The spring yielded about 20 gallons a minute, temperature 50° F.

	In 10,000 parts of the water.
Sulphate of potash	·1243
do. soda	1·5247
do. lime	·6122
do. magnesia	·5636
Chloride of sodium	·2846
Carbonate of lime	3·7458
do. magnesia	·1037
do. iron	·0486
Alumina	·0117
Silica	·1528
Total	7·1720

Mr. Beesley stated more recently that the chalybeate water of Astrop is now brought in pipes from the original St. Rumbald's Well, a Holy Well, near Astrop House, by no means to the improvement of its tonic quality.[3] The water now discharges from a pipe in a small enclosure by the road-side. (B.T., 1908).

The spring rises below the base of the Marlstone in sandy micaceous clays belonging to the Middle Lias.

In 1749 a new well at Sutton was opened, probably the following one.

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[1] G. Baker, Hist. Northants., p. 703.

[2] *Pharmaceutical Journal.*

[3] *Banburyshire Nat. Hist. Soc. and Field Club*, July, 1882.

2. The SUTTON or "Sutton Bog" Spring, rises in a field north-east of King's Sutton railway station on the western side of the village. Mr. Beesley remarks that it is a saline spring containing a very little iodine, and that the water is still (1882) used by the villagers.[1] The water supply is maintained at all seasons.

Mr. Beesley's analysis is as follows:—

	Grains per gall.	In 10,000 parts of the water.
Sulphate of potash - - - -	0·08	·1542
,, soda - - - - -	104·55	14·9336
Chloride of sodium - - - -	57·155	8·1650
Iodide of sodium - - - - -	10·49	·0071
Carbonate of soda - - - -	16·47	2·3530
,, lime - - - -	6·28	·8949
,, magnesia - -	2·95	·4222
Oxide of iron and alumina - -	0·75	·0107
Silica - - - - - - - -	0·56	·0804
	199·28	27·0211

Long Buckby.

According to a report by Dr. R. Bruce Low to the Local Government Board in 1896, Long Buckby then derived its water supply from about 116 local wells, some of which were public wells. The water was almost wholly derived from shallow wells sunk in sand and gravel overlying Upper Lias clay, and these wells were either already polluted or in constant danger of pollution. Numerous analyses of the waters were published in the Report, and a geological section by Mr. Beeby Thompson was also given. As steps have since been taken to obtain an appropriate supply, it will be unnecessary to reproduce the analyses of the old well-waters.

1. SOURCE. Boring 332 feet into Middle Lias.

Yield about 45,000 gallons per diem.

(*N.B.*—In the permanent well only 20 feet distant from this borehole a large volume of water was obtained at a depth of only 252 feet).

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board.

——	Results in grains per gallon.	
	No. 1. April 7th, 1899.	No. 2. May 3rd, 1899.
Total solid residue - - - - - -	70·28	68·04
Oxidisable organic matter - - - -		·06
Free ammonia - - - - - - -	·0300	·031
Albuminoid ammonia - - - - - -	·0021	·003
Lime - - - - - - - - - -	17·41	17·36
Magnesia - - - - - - - - -	4·47	4·13
Oxide of iron and alumina - - - -	3·16	Traces
Silica - - - - - - - - - -		·89
Nitric acid - - - - - - - -	None	None
Sulphuric acid - - - - - - -	20 44	19·64
Chlorine - - - - - - - - -	1·71	1·71
Equal to chloride of sodium - - -	2·82	2·82

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[1] *Banburyshire Nat. Hist. Soc. and Field Club*, July, 1882.

By Dr. Bernard Dyer, 1899.

	Grains per gallon.
Total dissolved matter	67·20
Free (actual or saline ammonia)	·020
Albuminoid (organic) ammonia	·001
Chlorine in chlorides	1·90
(Equal to chloride of sodium)	(3·13)
Nitrogen in nitrates	Inappreciable.
(Equal to nitric acid)	(—)
Oxygen absorbed by oxidisable organic matter, etc., from a solution of permanganate of potash at a temperature of 80° Fahrenheit:—	
In 15 minutes	·010
In 4 hours	·016
Phosphoric acid	Traces.
Lime	16·63
Magnesia	4·23
Sulphuric acid (anhydrous)	20·65

"It is pure water in the sense that it is quite free from sewage, or any similar impurity."

Milton.

Water from Marlstone.

Analysis by Messrs. A. Boaket & Co., Stratford, of water from a well at East's Brewery, Milton. 1878.

Communicated by Mr. Beeby Thompson.

	Grains per gallon.
Total solid matter	61·60
Mineral matter	59·84
Volatilized matter, blackening when heated	1·76
Degrees of hardness before boiling	31·00
,, ,, after boiling	17·00
Free ammonia and as salt	·0056
Ammonia in volatilized matter	·0224

Composition of the mineral matter.

Silica	0·88
Oxide of iron	A trace.
Carbonate of lime	16·80
Sulphate of lime	14·73
Nitrate of lime	7·69
Carbonate of magnesia	4·72
Chloride of sodium, with a small quantity of chloride of potassium	8·43
Carbonate of soda	6·40
Loss on analysis	0·19

Newbottle.

Source.—Spring.

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	31·36
Oxidisable organic matter	·19
Lime	14·05
Magnesia	·31
Sulphuric acid	2·87
Nitric acid	1·91
Chlorine	1·22
Equal to chloride of sodium	2·00
Free ammonia	None.
Albuminoid ammonia	·003

The water contained only a trace of suspended matter. The residue left on evaporation to dryness amounted to 31·36 grains per gallon, consisting mainly of lime salts, sulphate of lime as well as carbonate being present. The water is one of a hard character.

The analysis shows comparatively little dissolved organic matter and hardly any ammonia, and the water may be considered a fit drinking supply.

Northampton.

1, 2, 3, 4, 5, 6, 7. Northampton Sand Waters.

Communicated by Mr. Beeby Thompson.

The following particulars are taken from a MS. in a collection of Local Views Charters, Maps, Bills of Sale, particulars of Building Land, &c., collected and bound in a large folio volume by Thomas Grundy; now in the Reference Library of the Northampton Museum.

Report of the chemical examination and Analysis of four specimens of water from Northampton, received from Mr. Barlow on the 13th August, 1836, by John Thomas Cooper, Professor of Chemistry, 82, Blackfriars Road.

1. From NEAR THE ASYLUM.

(St. Andrew's Hospital. B.T.)

An imperial gallon contains :—	Grains.
Carbonate of lime	14·10
Sulphate of lime	2·15
Muriate of lime	2·00
Muriate of soda	·50
And a very minute trace of oxide of iron and organic matter	[1.0 ?]
	19·75

It also contains some Carbonic Acid and Nitrogen gases in the proportion of about 15 cubic inches of the former and 5 cubic inches of the latter in the gallon, but for the accurate determination of the quantities of these the examination should be made as soon as possible after the water is taken from the supply; this remark will of course apply to all the samples.

2. From the RACE COURSE.

An imperial gallon contains :—	
Carbonate of lime	9·30
Muriate of lime	2·25
Muriate of soda	·53

A minute trace of lead and magnesia making the amount of foreign matter equal to 12·08 grains.

The gaseous contents in the gallon are :—	Cubic Inches.
Carbonic acid	12
Nitrogen	5

3. From MR. GRUNDY'S BRICKYARD.

(Close to the Race Course, where Park Crescent, &c., stand now.—B. T.)

An imperial gallon contains :—	Grains.
Carbonate of lime	20·95
Sulphate of lime	3·70
Muriate of lime	2·35
Muriate of soda	2·15
Muriate of magnesia	1·50
A trace of iron, rather more than No. 1., and also a little more organic matter, but this may have arisen from some straws which were found in the bottle when it was nearly emptied	
	30·65

The gaseous contents were the same as No. 1. viz. :

15 cubic inches of Carbonic acid.
5 ,, ,, ,, Nitrogen.

The fourth sample was from the River, and is given further on.

4. Spring Lane Water.

Analysis by Beeby Thompson. 1900.

	Parts per million.
Free ammonia	·013
Albuminoid ammonia	·014
Total oxygen absorbed at 100° C.	2·240
	Grains per gallon.
Chlorine	6·6
Temporary hardness as calcium carbonate	3·2
Permanent „ „	9·8
Total hardness	13·0
Total solid residue	65·0

5. Well in Angel Lane, Electric Light Works.

Analysis by Dr. Hepburn.

	Parts per 100,000
Total solids (at 120° C.)	95·40
Lime (CaO)	1·48
Magnesia (MgO)	1·40
Sulphuric acid (SO_3)	13·58
Carbonic acid—Free (CO_2)	2·42
Chlorine (Cl)	15·26
Bicarbonate of soda ($NaHCO_3$) corresponding to excess of alkalinity over hardness.	58·56
	Degrees.
Hardness	3·60
Alkalinity	28·00

6. St. Thomas à Becket's Well.

Analysis by Mr. John Clower. 1892.

	Parts per million.
Free ammonia	·01
Albuminoid ammonia	·11
	Grains per gallon.
Chlorine	5·00
Total solid matter	52·00

7. Spring in Vigo-Brickyard.

Analysis by Mr. Lawrence Briant.

	Parts per million.
Free ammonia	·005
Albuminoid ammonia	·050
Oxygen required to oxidise organic matter	·290
	Grains per gallon.
Total solid residue dried at 212° F.	56·28
Saline residue	52·80
Organic and volatile matter and water of crystallisation.	3·48
Lime	15·60
Magnesia	1·16
Soda	7·56
Potash	0·53
Sulphuric acid	8·35
Nitric acid	7·67
Nitrous acid	Nil.
Chlorine	4·20
Lead, etc.	Nil.
Iron	Trace.

Probable constitution of the saline residue :—

	Grains per gallon.
Chloride of sodium	6·93
Sulphate of potash	0·98
Sulphate of soda	8·91
Sulphate of lime	4·89
Nitrate of lime	11·65
Carbonate of lime	17·06
Carbonate of magnesia	2·43

8, 8a, 9. Marlstone Waters.

8. Waterworks Well, May 11th, 1868

Sixth Report of the Rivers Pollution Commission, 1874, p. 95.

Composition of unpolluted water from a deep well in the Middle Lias.

	Results in parts per 100,000.
Depth of well in feet	191.
Dissolved matters :—	
Total solid impurity	57·76
Organic carbon	·168
Organic nitrogen	·024
Ammonia	·003
Nitrogen as nitrates and nitrites	—
Total combined nitrogen	·026
Previous sewage or animal contamination	—
Chlorine	5·15

Hardness.	Degrees.
Temporary	8·6
Permanent	1·7
Total	10·3

Clear and palatable.

8a. Waterworks Well. December, 1897.

Analysis by Mr. Lawrence Briant.

	Parts per million.
Free ammonia	·546
Albuminoid ammonia	·025
Oxygen required to oxidise organic matter	·390
	Grains per gallon.
Total solid residue dried at 212° F	48·16
Saline residue	46·93
Organic and volatile matter and water of crystallisation	1·23
Lime	5·72
Magnesia	1·71
Soda	16·79
Potash	0·21
Sulphuric acid	7·73
Nitric acid	Nil.
Nitrous acid	Nil.
Chlorine	3·99
Poisonous metals	Nil.
Iron	Distinct Trace.

Probable constitution of the Saline Residue :—

	Grains per gallon.
Chloride of sodium	6·58
Sulphate of potash	0·39
Sulphate of soda	13·40
Carbonate of soda	12·75
Carbonate of lime	10·22
Carbonate of magnesia	3·59

9. Waterworks Well.

Analyses by Sir Thomas Stevenson.

Communicated by Mr. F. Tomlinson.

	Grains per gallon.	
	April, 1900.	Aug., 1907.
Free ammonia	·0430	·056
Albuminoid ammonia	·0035	·001
Oxygen absorbed at 15° C	·013	·021
Chlorine	3·64	5·24
Hardness—all temporary	15·20	12·30
Total solids	47·88	52·08
Loss on ignition	·56	3·08
Nitrogen as nitrates	·01	Trace.
Nitrites	None	None.

10. Water from River Gravel.

Sample drawn from hydrant on Abington Square, Northampton, July, 1884, when used for flushing purposes. Analysis by Mr. Beeby Thompson.

	Parts per million.
Free ammonia	·132
Albuminoid ammonia	·374
	Grains per gallon.
Chlorine	6·1
Temporary hardness as calcium carbonate	9·9
Permanent do do	10·5
Total do do	20·4
Total solid residue	50·0

River gravel water varies considerably in composition at different times as might be expected. Of actual records the variation at Northampton in free ammonia is from ·132 parts per million to ·4 ; albuminoid ammonia ·05 to ·374 ; chlorine 1·5 grains per gallon to 6·3 ; Total solids 50 to 90 grains per gallon.
B.T.

11. Water from RIVER NENE.

Analysis by Mr. John Thomas Cooper, August 1836 (from Grundy M.S.)
An Imperial gallon contains :—

	Grains.
Carbonate of lime	42·10
Sulphate of lime	14·37
Muriate of lime	4·01
,, of magnesia	·85
,, of soda	2·20
With a greater quantity of organic matter than either No. 1 or No. 3.	
	63·53

12. Stream Water ST. JAMES' END.

Analysis by Mr. Beeby Thompson (April, 1907).

	Parts per million.
Free ammonia	1·16
Albuminoid ammonia	·09
Total oxygen absorbed at 100° C.	3·60
	Grains per gallon.
Chlorine	1·7
Hardness as calcium carbonate	18·6
Total solids	22·9

Norton.

1. Public supply to Village from SPRING on side of BOROUGH HILL.

Water from Northampton Sand.
Communicated by Dr. J. C. Thresh.

	Parts per million.
Free ammonia	0·000
Organic ammonia	0·050
Oxygen absorbed (4 hrs. 80° F.)	0·220
	Grains per gallon.
Chlorine as chlorides	1·3
Nitrogen in nitrates	0·48
Total solids	9·0
Total hardness	4·0

2. SHALLOW WELL.

Analysis communicated by Dr. J. C. Thresh.

	Parts per million.
Free ammonia	0·00
Organic ammonia	0·06
Oxygen absorbed (4 hours at 80° F.)	0·72
	Grains per gallon.
Chlorine in chlorides	3·5
Nitrogen in nitrates	·56
	Degrees.
Permanent hardness	10
Temporary hardness	4

Oundle.

Communicated by Dr. J. C. Thresh.

Well bored by Messrs. Le Grand and Sutcliff, 1900.

	Parts per million.
Free ammonia	1·0
Organic ammonia	0·10
Oxygen absorbed	1·92
	Grains per gallon.
Chlorine in chlorides	2·3
Nitrogen in nitrates	0·11
	Degrees.
Permanent hardness	4·5
Temporary hardness	21·5

Turbid, a little oxycarbonate of iron.

Peterborough.

Well at Phœnix Brewery, about a mile N.E. of the Cathedral.

Made by Mr. W. Elborne (1902 ?) Communicated to Mr. Whitaker by Mr. A. C. Young.

Depth, 68 feet. Temperature, 52° F. all the year round. Water occurs in a white sandy seam in blue [Oxford] clay.

No nitrates or nitrites.

Free ammonia	·07
Albuminoid ammonia	·002
	Grains per gallon.
Bicarbonate of soda	62·6
Chloride of soda	45·39
Sulphate of soda	12·
Carbonate of lime	1·7
Carbonate of magnesia	1·05
Silica	·63
Total	123·37

Potterspury.

Source.—Spring in Oolite (clay marl), yield 33,171 gallons per diem in July, 1896, said always to have a copious flow and not to fluctuate with the rainfall.

By Dr. A. Voelcker.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	29·68
Oxidisable organic matter	·13
Lime	13·16
Magnesia	·90
Nitric acid	·89
Sulphuric acid	2·79
Chlorine	1·10
Equal to chloride of sodium	1·81
Free ammonia	Trace
Albuminoid ammonia	Trace

The water was colourless, but slightly turbid, and on evaporation to dryness left a residue amounting to 29·68 grains per gallon, consisting mainly of carbonate of lime.

The water, in consequence of lime salts present, is decidedly hard, but very free from organic impurity, or anything of an objectionable character, so that though inconveniently hard for ordinary domestic uses, it is perfectly good for drinking.

Pytchley.

Source—Well 58 feet deep, (*see* p. 146.)

By Mr. Beeby Thompson, F.G.S., F.C.S. 1901.

Communicated by the Local Government Board.

	Parts per million.	Grains per gallon.
Ammonia, free	·01	·0007
,, albuminoid	·03	·0021
Oxygen absorbed at 100° C.	1·4	·0980
Solid residue, total		32·5
Chlorine		1·3
Equal to chloride of sodium		2·1

Hardness.	Degrees.
Temporary	20·2
Permanent	5·3
Total	25·5

Appearance—A little opalescent, evidently due to its having been collected during progress of the work.

Odour at 65° C.	None
Sediment	Small

Microscopical examination of sediment—mostly fine mineral matter, a few vegetable cells.

The solid residue is white, and consists chiefly of Carbonate of Lime. The other constituents of the residue are magnesia, soda, and a trace of potash, in the form of carbonates, sulphates, or chlorides.

This is very good water from a hygienic point of view; the amount of hardness is a slight drawback which is unavoidable in waters derived from the Oolitic rocks of the district.

Quinton.

Well. Water from Great Oolite Limestone.

Analysis by Mr. Beeby Thompson.

	Grains per gallon.
Free ammonia	·0011
Albuminoid ammonia	·0050
Total oxygen absorbed at 100° C.	·0931
Chlorine	1·1
Hardness, as calcium carbonate, in degrees	25·0
Total solid residue	33·0
Colour	none : bright and clear.

Raunds.

Communicated to Mr. Beeby Thompson by Mr. Thos. Yorke, Surveyor, Raunds.
Water from Trial well in "Communis beds" towards base of the Upper Lias.

	Grains per gallon.
Free ammonia	·1183
Albuminoid ammonia	·0035
Oxygen absorbed by organic matter in 15 minutes at 140° F.	·0840
Chlorine	133·00
Equal to chloride of sodium (common salt)	219·18
Total solid matter	265·00
Appearance in 2-foot tube	Very turbid.
Odour when heated to 100° F.	None.
Metals	None.
Microscopic examination	Deposit of earthy matter.

Analyses of waters from various shallow wells in Raunds are given in Dr. R. Bruce Low's Report to the Local Government Board, 1896.

Ravensthorpe.

1. Reservoir Water.

Analysis by Mr. Lawrence Briant. Dec. 1897.

	Before filtration.	After filtration.
	Parts per million.	
Free ammonia	·195	·010
Albuminoid ammonia	·160	·150
Oxygen required to oxidise organic matter	1·53	1·20
	Grains per gallon.	
Total solid residue dried at 212°F.	12·04	—
Saline residue	10·64	—
Organic and volatile matter and water of crystallization	1·40	—
Lime	3·76	—
Magnesia	0·50	—
Soda	0·92	—
Potash	0·24	—
Sulphuric acid	1·63	—
Nitric acid	Nil	—
Nitrous acid	Nil	—
Chlorine	1·05	—
Lead	Nil	—
Iron	Trace	—

Probable constitution of saline residue :—

Chloride of sodium	1·73
Sulphate of potash	·44
Sulphate of lime	2·43
Carbonate of lime	4·93
Carbonate of magnesia	1·05

2. New Well. Water from Middle Lias. Analysis by Sir T. Stevenson. Communicated by Mr. F. Tomlinson. April 1906.

	Grains per gallon.
Free ammonia	·0620
Albuminoid ammonia	·0015
Oxygen absorbed	·045
Chlorine	1·52
Hardness—all temporary	11·20
Total solids	54·61
Loss on ignition	4·48
Nitrates	Trace
Nitrites	None

Rothwell.

Source—Sholwell Spring, at Junction of Northampton Sand and Upper Lias Clay.

Yield—140,000 gallons per 24 hours. July, 1901.

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	30·80
Free ammonia	None.
Albuminoid ammonia	·001
Oxidisable organic matter	·02
Lime	12·79
Magnesia	1·00
Sulphuric acid	2·44
Nitric acid	·67
Chlorine	·99
Equal to chloride of sodium	1·64

The water was colourless. On evaporation to dryness it left a residue amounting to 30·8 grains per gallon, which consisted largely of carbonate of lime, the water being one of a distinctly hard character. It is very free from organic impurity, and also, in my opinion, from contamination. Although a hard water, and consequently not convenient for general domestic use, it is, I think, perfectly good for drinking. The sample contained a slight deposit which should be removed by filtration.

Stanion.

Source.—Well near to Reservoir in Inferior Oolite series.
Mostly Northampton Sand Water.
By Mr. Beeby Thompson, F.G.S., F.C.S.
Communicated by the Local Government Board.

	Results in parts per million.
Free ammonia	·11
Albuminoid ammonia	·13
Total oxygen absorbed at 100° C.	2·20
	Grains per gallon.
Chlorine	1·4
Hardness	degrees 20·6
Solid residue (mostly carbonates)	34·5
Appearance	Clear and bright.
Odour at 65° C.	None.
Sediment	Very small—negligible.

Towcester.

Source—Artesian boring (*see* p.).
By Mr. Jno. Bingley, F.C.S.
Communicated by the Local Government Board.

	Results in parts per million.
Free ammonia	·62
Albuminoid ammonia	·04
	Results in grains per gallon.
Chlorine in chlorides	4·8
Nitrites	None.
Nitrogen in nitrates	·09
Hardness.	Degrees.
Temporary	5
Permanent	4
Total	9
Total solid matter dried at 212° Fah.	38
Lead	None.

This water is of good quality for drinking and general domestic purposes, and quite suitable in every respect for a public supply.

Upper Heyford.

GLASSTHORPE HILL.
Water from Marlstone.
Analysis by Mr. Beeby Thompson, F.G.S., F.C.S.

	Parts per million.
Free ammonia	·04
Albuminoid ammonia	·08
Total oxygen absorbed at 100° C.	2·40
	Grains per gallon.
Chlorine	1·9
Temporary hardness, as calcium carbonate	23·8
Permanent ,,	88·2
Total hardness	112·0
Total solid residue	148·3
Approximate composition of the solid residue.	
Calcium carbonate	23·80
Calcium sulphate	43·66
Magnesium sulphate	47·58
Sodium sulphate	9·22
Sodium chloride	3·10
	127·36
Sedimentary matter, water of crystallization and loss	20·94
	148·30
After prolonged pumping—	
Total hardness	76·3
Total solids	104·5

Upton.

Berry Wood Asylum.

1. Water from Northampton Sand.

Analysis by Dr. Emmerson, Leicester. February, 1892.

Appearance in 2-foot tube	clear
Smell when heated to 100° (F.?)	none
Microscopical examination	no deposit
Oxygen absorbed in 2 minutes at 80° (C. ?)	·0055
Solids (grains per gallon)	15·20
Chlorine	1·7
Free ammonia	·0030
Albuminoid ammonia	·0028
Hardness in degrees	18·5

A good water and fit for all domestic purposes.

2. Water from Marlstone. Deep well.

Analysis by Dr. Emmerson. October, 1894.

Appearance in 2-foot tube	clear
Odour when heated to 100° (F. ?)	faint
Microscopical examination	satisfactory
	Grains per gallon.
Oxygen absorbed in 2 minutes at 80° C.	·0086
Chlorine	13·15
Free ammonia	·0064
Albuminoid ammonia	·0048
Hardness in degrees	none

Not free from organic matter, but within the limits allowed for domestic use.

Analysis by Mr. Beeby Thompson, 1901.

	Grains per gallon
Chlorine	7·5
Solid residue	60·3
,, ,, after ignition	57·8
Hardness about one degree	1·0

Alkaline.
Attacks glass on long standing.
Solid residue deliquescent.

Approximate composition of solid residue :—

Sodium chloride	12·35
,, sulphate	13·06
,, carbonate	20·42
Magnesium carbonate	2·50
Calcium carbonate	2·01
Organic and other volatile matter	2·50
Matter insoluble after ignition	5·30
	58·14

The result of mixing this peculiarly soft water with the hard Northampton Sand water seems to result in a highly satisfactory supply for all domestic purposes.

3. Garner's Spring, near Berry Wood Asylum, March 1871.

Sixth Report, Rivers Pollution Commission 1874, p. 119.

Composition of Spring Water from the Northampton Sand. Now used as a public water supply for Kislingbury.

	Results in parts per 100,000.
Dissolved matters :—	
Total solid impurity	31·36
Organic carbon	·009
Organic nitrogen	·003
Ammonia	0
Nitrogen as nitrates and nitrites	·790
Total combined nitrogen	·793
Previous sewage or animal contamination	7·580
Chlorine	1·76
Hardness.	Degrees.
Temporary	17·4
Permanent	5·9
Total	23·3

Clear and palatable.

4. TURNER'S SPRING, near Berry Wood Asylum.

Analysis by Mr. Laurence Briant. 1898.

	Parts per million.
Free ammonia	nil.
Albuminoid ammonia	·020
Oxygen required to oxidise organic matter	·270
	Grains per gallon.
Total solid residue dried at 212° F.	34·72
Saline residue	31·47
Organic and volatile matter	3·25
Lime	11·91
Magnesia	·75
Soda	2·24
Potash	·51
Sulphuric acid	2·54
Nitric acid	4·32
Nitrous acid	nil.
Chlorine	2·38
Poisonous metals	nil.
Iron	bare trace.

Probable constitution of the saline residue :—

Chloride of sodium	3·83
Sulphate of soda	·48
Sulphate of potash	·94
Sulphate of lime	3·13
Nitrate of lime	6·56
Carbonate of lime	14·96
Carbonate of magnesia	1·57

Warkton

Some analyses of waters from wells and springs at this locality were published in the Sixth Report of the Rivers Pollution Commission, 1874, pp. 81, 119.

Welland River.

On border of Northamptonshire, near Stamford.

Communicated by Dr. J. C. Thresh.

	Grains per gallon
Chlorine in chlorides	1.96
Nitrogen in nitrates	0·16
Permanent hardness	5·8
Temporary hardness	11·5
	Parts per million.
Free ammonia	0·06
Organic ,,	0·20
Oxygen absorbed (4 hours at 80° F.)	1.74

Wellingborough.

1. Well at HARDWICK, 17 feet deep, water derived from Northampton Sand and Ironstone resting on Upper Lias clay.

Yield 135,000 gallons in 24 hours.

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board.

	Results in grains per gallon]
Total solid residue	43·68
Free ammonia	·004
Albuminoid ammonia	·003
Oxidisable organic matter	·24
Lime	15·57
Magnesia	2·47
Sulphuric acid	8·89
Nitric acid	Trace
Chlorine	1·53
Equal to chloride of sodium	2·52

The residue obtained on evaporation to dryness consisted mostly of lime salts (Carbonate and Sulphate), together with magnesia salts. The water is, by reason of these salts, of a markedly hard character, and as such could not be called a convenient one for washing and domestic uses generally.

The water has not any considerable amount of dissolved organic matter, but the amount of ammonia is perhaps a little high. This may, in part, be attributed to the supply being a new one.

The water, while hard and inconvenient for general use, is not polluted with harmful matter, and could be used for drinking.

2. HARDWICK Water. 3. BUSHFIELDS Water.

Analyses by Mr. William T. Burgess, F.I.C. Feb., 1906.

Communicated by Mr. E. Y. Harrison.

	2	3
	Parts per 100,000.	
Matters in solution—		
Total solid matter	67·720	68·320
Organic carbon	·073	·085
Organic nitrogen	·009	·010
Ammonia, free	·002	·0045
Ammonia, albuminoid	·003	·003
Nitrogen as nitrates	·014	·164
Nitrogen as nitrites	nil.	nil.
Total combined nitrogen	·025	·178
Oxygen consumed (4 hours at 80° F.)	·021	·021
Combined chlorine	2·10	1·90
Total hardness (calculated)	51·30	54·10
Total lime (Ca O)	23·98	25·64
Total magnesia (MgO)	3·46	3·32
Oxide of iron (Fe_2O_3)	·06	·06
"Alkalinity" (eq. of carbonate of lime)	33·70	34·70
Carbonic acid, fixed (CO_2)	14·80	15·30
Sulphuric anhydride (SO_3)	14·11	14·12
Matters in suspension—		
Carbonate of lime $CaCO_3$)	—	—
Oxide of iron (Fe_2O_3)	·05	·22

The difference in the analytical results of the Hardwick waters 1 and 2 may be explained by the remarks under Hardwick in description of wells. B.T.

Wilby.

1. Well, 30 feet deep at junction of Northampton Sand and Upper Lias Clay. 227·65 feet above Ordnance Datum. 13 feet in clay.

Yield 20,150 gallons per day.

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board. 1904.

	Results in grains per gallon.
Total solid residue	35·56
Free ammonia	Trace
Albuminoid ammonia	·002
Oxygen absorbed by oxidisable organic matter	·016
Nitrogen as nitrates	·552
Equal to nitric acid	2·13
Chlorine	1·52
Equal to chloride of sodium	2·50

The water was practically clear and colourless. It is a decidedly hard water owing to the considerable quantity of Sulphate and Carbonate of Lime present, and consequently is not a convenient one for general use. As a drinking supply it is fairly satisfactory.

2. Source, Well 55 feet in Northampton Sand.

Water actually came from the Estuarine limestone (see p.168). Supply insufficient.

By Dr. E. W. Voelcker, County Analyst.

Communicated by the Local Government Board.

	Results in grains per gallon.
Total solid residue	39·76
Free ammonia	Trace.
Albuminoid ammonia	·002
Oxygen absorbed	·023
Lime	16·10
Magnesia	·62
Sulphuric acid	5·77
Nitric acid	2·98
Chlorine	1·57
Equal to chloride of sodium	2·59

The water was slightly turbid owing to some suspended matters. It is a very hard water and not thoroughly satisfactory.

Woodford.

Source—Spring near river Nene, from Northampton Sand.

Yield—61,200 gallons per diem in January, 1896, but said to be nearly dry in dry summers, and also liable to be overflowed by floods.

(Proposal not approved by Local Government Board.)

By Dr. E. W. Voelcker, County Analyst, 1896.

Communicated by the Local Government Board.

	Result in grains per gallon.
Total solid residue	38·08
Oxidisable organic matter	·10
Free ammonia	Trace.
Albuminoid ammonia	None.
Lime	15·40
Magnesia	1·21
Nitric acid	1·10
Sulphuric acid	·74
Chlorine	1·10
Equal to chloride of sodium	1·70

The water was colourless and almost perfectly clear. On evaporation to dryness it left a white residue amounting to 38 grains per gallon, consisting mainly of carbonate of lime. The water is, in consequence of this considerable amount of carbonate of lime, a very hard one, but it is very free from any organic impurity and contains nothing of an objectionable character.

Although very hard for ordinary domestic use, it is, in my opinion, a perfectly good water for drinking purposes.

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Maps.

Sheets of the Index Map. Scale one inch to four miles.

Old Series. Sheets 8, 9, 11 and 12 ;
New Series. Sheets 12 and 16 (with Drift).

Sheets of the Map. Old Series. Scale one inch to a mile.

		Bedfordshire.	*Northamptonshire.*
45	N.W.	——	King's Sutton.
	N.E.	——	Brackley, Whittlebury.
46	N.W.	Woburn	Potterspury.
	N.E.	Ampthill, Biggleswade.	——
	S.W.	Leighton Buzzard, Dunstable	——
	S.E.	Luton	——
52	N.W.	Winnington	Kettering, Wellingborough.
	N.E.	Tilbrook, Pertenhall	Titchmarsh.
	S.W.	Harrold, Biddenham	Northampton.
	S.E.	Bedford, Potton	——
53	N.W.	——	Small area W. of Barby.
	N.E.	——	Naseby, Long Buckby.
	S.W.	——	Chipping Warden.
	S.E.	——	Daventry, Towcester.
63	S.E.	——	Oxenden Magna.
64		——	Peterborough, Oundle.

Sheets of the Map. New Series. Scale one inch to a mile.

187	Eaton Socon.	——
203	Bedford, Harrold	Yardley Hastings.

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RAINFALL MAP
OF
BEDFORDSHIRE.

By *H. R. Mill, D.Sc., LL.D.*

REFERENCE.

Rainfall below 22·5 inches - - - ☐
,, between 22·5 & 25·0 inches - - ░
,, ,, 25·0 & 27·5 ,, - - ▒
,, above 27·5 inches - - - ▓

Scale, 1 Inch = 10 Miles.

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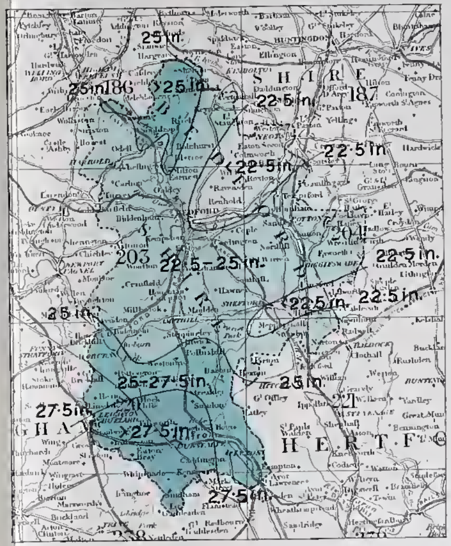
GEOLOGICAL SURVEY OF ENGLAND



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RAINFALL MAP
OF
NORTHAMPTONSHIRE.

By H. R. Mill, D.Sc., LL.D.

REFERENCE.

Rainfall	below 22·5 inches	☐
„	between 22·5 & 25·0 inches	▤
„	„ 25·0 & 27·5 „	▥
„	above 27·5 inches	▦

Scale — 1 Inch = 10 Miles

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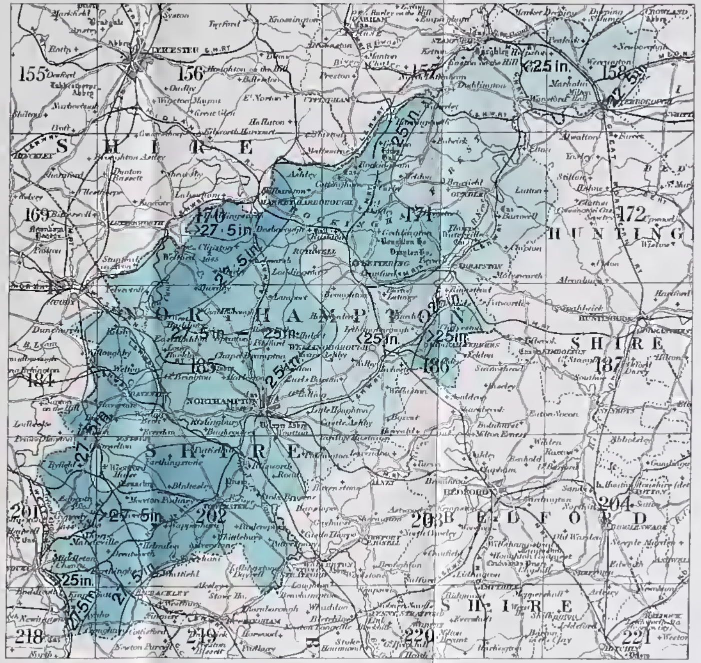
GEOLOGICAL SURVEY OF ENGLAND.



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